New Valley Journal of Agricultural Science
Published by Faculty of Agriculture, New Valley University, Egypt
DOI: 10.21608/NVJAS.2023.204066.1192
Research Article Open Access

Effect of Intercropping and Fertilization on The Yield and Quality of Stevia as a Natural Sweetener

Basma R.A. Rashwan[1] Reem Mohamed Abd- El Raouf[2] and Nagwa R Ahmed[3]

[1]Plant Nutrition Department, Soils, Water and Environment Research Institute, Agriculture Research Center, Giza, Egypt.
[2]Medicinal and Aromatic Plants Research Department, Horticulture Research Institute, Agriculture Research Center, Giza, Egypt.
[3]Field Crops Research Institute, Agriculture Research Center, Giza, Egypt.

*** Corresponding author**
Basma R.A. Rashwan

Received: 04/04/2023
Revised: 30/05/2023
Accepted: 03/06/2023
Published:03/06/2023

Abstract

Due to the need of stevia plants to moderate temperature throughout the year and the high costs of its production inside greenhouses, therefore the Intercropping may be the optimum solved to get up heating in winter and shading in summer in addition to increasing the cropping area. The cultivation of these economic crops is needed to fill the nutritional gap of grains and oils. Field experiment was conducted through 2019/2020 and was replicated at 2020/2021 in the Experimental Farm of Mallawi Agricultural Research Station, El-Minia Governorate, Egypt to investigate the effect of some Intercropping patterns and fertilizers combination on the yield and quality of stevia as a natural sweetener. Randomized complete blocks design in split-plot arrangement was used where, the main plots consisted of five Intercropping patterns, while the fertilizers combinations were assigned in sub plot. Results showed that Intercropping pattern had a significant effect on most aspects of growth in both seasons. It was noticed that the treatment of 80% N mixed with Biofertilizers, and compost surpassed the other treatments in both seasons. The net profit of using mixing biofertilizer + Compost plus 80 % mineral N fertilizer for stevia and wheat intercrop recorded 651.075 &691.403 L.E. fed in the1st and 2nd successive seasons, respectively.

Key words: *Intercropping patterns, Stevia rebaudiana, natural sweetener*.

Introduction

Stevia (*Stevia rebaudiana*, Bertoni) is an herbaceous perennial plant of the Asteraceae family, native to Paraguay South America **(Ribeiro et al., 2021).** Stevia sweet is mainly due to steviol glycosides, that are ~250-300 times sweeter than sucrose **(Peteliuk et al., 2021).** Diterpene glycosides produced by stevia leaves are many sweeter than sucrose therefore we can be utilized as a good substitute to sucrose **(Yadav et al., 2010).** Stevia is a natural source of non-caloric sweetener and alternatives to the synthetic sweetening materials that are now available to diet conscious consumers. The potential uses of *Stevia rebaudiana*, which produces setivoside, a non-caloric sweetener that does not metabolize in the human body **(Khiraoui et al., 2017 and Kumari & Malhotra 2021).** Stevia cannot tolerate frost and so growth ceases during winter **(Megeji et al., 2005)**. Due to the cessation of growth during winter, the available growth resources such as light, space, moisture and nutrients are insufficiently utilized from October to March. This offers an opportunity for *S. rebaudiana* growers to cultivate another species as an intercrop to make *S. rebaudiana* more portable in accordance with the traditional food production system. However, to our knowledge, this is the first information on Intercropping with stevia. Considering the growing interest of farmers in cultivating this crop due to higher returns. **Lulie & Bogale (2014)** showed that sole planting of stevia was superior to other intercropped treatments. The Land Equivalent Ratio (LER) and Monetary advantage index (MAI) indicate the practice of Intercropping of haricot bean with stevia was more advantageous than the conventional monoculture crop. Even if significant yield difference was not observed for haricot bean among the treatment, haricot bean intercrop with 80% stevia mix proportion with LER of 1.43 and MAI of 88278 followed by 60% stevia mix proportion with LER of 1.34 and MAI of 62027 proved to be best than planted at sole indicating the practice of haricot bean –stevia Intercropping was more advantageous and profitable than the conventional monoculture crop. Intercropping reduced the production of *S. rebaudiana* up to 50% when compared to sole cropping. Intercropping with wheat increased the stevioside content when compared to other intercrops. The introduction of wheat resulted in higher monetary benefits. Results indicated that reduction in *S. rebaudiana* biomass was mainly due to overlapping of the emergence period of the main crop with rapid growth and development of the intercrops **(Ramesh & Ahuja 2007 and Sharma&Kumar 2016).**

Patil (2010) indicated that chemical treatment increased plant growth when compared to control. Vermicompost treatment increased growth compared to control but not as much as observed in combination of organic and inorganic treatment. However, a combination treatment of biofertilizer and chemical fertilizer increased chlorophyll, growth, carbohydrates and proteins content compared to control. Therefore, it is necessary to evaluate and develop a balanced fertilization strategy that combines the use of chemical, organic or biofertilizer. Combined application of organic and inorganic fertilizers increases plant growth, yield, quality and soil fertility in plants **(Mahmoud et al., 2009; Gao et al., 2020 and Mahmoud & Gad 2020).** Protein synthesis in growing plants is component of metabolic regulation which provides a way for varying the enzymatic complement during the response to environmental conditions (**Huffakar and Peterson, 1974)**. According to **Das et al., 2007 and Zaman et al., 2018,** the biomass increased progressively irrespective of treatments over control. However, the total fresh biomass production was recorded highest with combined application of biofertilizer when compared to sole application. The present investigation indicated that stevia plants respond better with respect to height, leaf area, chlorophyll, protein and carbohydrate content with combination treatment of NPK and vermicompost (2:1) T3 treatment compared to NPK or superphosphate with PSB or vermicompost alone. The type of nutrients released are different, whether chemical, organic or Biofertilizers. Each type of fertilizer has its advantages and disadvantages over crop growth and soil fertility. Thus, a sound organic manure provides a good substrate for the growth of microorganisms and maintains a favorable nutritional balance and soil physical properties. The results suggest that the application of vermicompost in combination with chemical fertilizers could be a superior recommendation for greater leaf biomass yield, stevioside content and nutrient uptake by stevia as well as maintaining soil health over the sole use of chemical fertilizers **(Zaman et al., 2018).** Chemical nitrogenous fertilizers are one of the main factors accelerating global warming that may cause some environmental problems, such as harmful algal bloom, loss of aquatic life and increasing gas nitrous oxides **(Sedlacek et al., 2020)**. The combined application of nitrogenous fertilizers and effective microorganisms improved growth, yield and nutrient accumulation in stevia **plants (Youssef et al., 2021)**. Cover crops and composts can provide a lot of N to plants, but synchronizing N release from these materials with plant the promoting effect of this treatment on dry leaf yield could be due to a positive interaction resulting from increased organic matter, soil structure and available nutrients after **cultivation (Ding et al., 2018 and Oldfield et al., 2019). Youssef et al., (2021),** who reported that the application of organic manure and its combination with biofertilizer increased the organic matter at the end of the experimental period. In addition, organic manure could promote plant growth, resulting in increased input of SOC into the soil through the plants **(Ding et al. 2012).** Using Biofertilizers is one of the most critical steps in crop production to increase plant growth, improve fruit quality and yield components of crops through the way of various biochemical activities. Hence, in current study, we not only investigated the individual and combined effect of effective microorganisms and nitrogenous fertilizers on yet unexplored aspects of stevia plant growth but also segregated treatment-dependent variations in plant vegetative growth, yield, and nutritional attributes of stevia. The predominant objective of the present study was to verify the integrated effects of Intercropping pattern and different levels of mixed chemical fertilizer with compost and biofertilizer on the growth, leaf biomass yield and stevioside content of stevia as well as post-harvest soil fertility.

Materials and Methods

Experimental Site

Two field experiments were conducted at Mallawi Agricultural Research Station, El-Minia Governorate, Egypt (27°44′N 30°50′E), during 2019/2020 and 2020/2021 seasons to deduce the effect of different combinations of fertilizer and some Intercropping patterns.

The experiments were allocated in a spilt plot arrangement in RCBD with three replicates. The main plots are assigned to Intercropping patterns.

1. 100% stevia + 50% sunflower in the summer season.
2. 100% stevia+ 50% maize in the summer season.
3. Between Intercropping stevia 100 %.
4. 100% stevia + 50% faba bean in the winter season.
5. 100 % stevia + 50% wheat in the winter season.

As well as the sub plots were devoted for four combinations of fertilizer.

1. Control (80, 60, 120, 20 and 75 kg N fed^{-1}): recommended fertilization dosages (RD) for stevia and Intercropping crops i.e., sunflower, maize, faba bean and wheat, respectively.
2. Biofertilizer + (80 % RD)
3. Compost + (80 %RD)

4. Mixture biofertilizer and compost + (80 %RD).

Experimental Details

Biofertilizers

Seedlings of stevia and seeds other crops Intercropping were soaked before planting with the Biofertilizers mixture of (*Azotobacter chroococcum and Bacillus megaterium*), were provided from Microbiological Unit, Agriculture Research Center, Giza, Egypt. The number of bacteria reached about 1×108 cell/ml.

Organic Fertilizers

Compost fertilizers (plant residues as commercial compost namely Nile compost). Compost was added at the rate of 5 ton fed^{-1} was broadcasted and thoroughly mixed with soil surface during plots preparation with all treatments. Chemical analysis of the compost used presented in Table 2b.

Chemical Fertilizers

Super calcium phosphate, 15.5% P_2O_5 at a rate of 150 kg/fed was broadcasted and thoroughly mixed with soil surface during plots preparation and 50 kg/fed potassium sulfate, 48% K2O was added with the second irrigation.

The sub plot area was 22 m^2 consisting of 5 beds, each of bed was 110 cm in width and, 4 m in length, on the bed's stevia planting at the two sides. The seedlings of stevia (*Stevia rebaudiana* Bertoni), Spanish cultivar, were purchased from the Sugar Crops Research Institute and grown in the Experimental Farm of Mallawi Agric., Res. Station. Stevoil was a perennial plant. Stevia plants were cut just prior to flowering where the concentration of steviol glycoside in the leaves is at its maximum, and glycoside synthesis is reduced at or just before flowering **Kumar et al., (2014),** leaving 10 cm up to ground level. Intercropping crops seeding on center beds at a rate of 50% from all crops alone. Faba beans were seeded after sunflower, wheat was seeded after maize in the two seasons. The crops and its cultivars were sunflower (Sakha 53), maize (Giza128), wheat (Sakha 193), faba bean (Giza 716). Solid plots of stevia and four crops sunflower, maize, wheat and maize were also included in each replication for comparison and determination of the competitive relationships and calculate the yield advantage of crops, total income and net return fed^{-1}. Wheat was planted in three lines in the center of the bed and the other crops were planted on two ridges. Soil analysis was done according to the method described by Jackson (1967). The physical and chemical properties of the experimental soil in **Table 2a**.

Data Recorded

Five plants of stevia/plots were selected randomly and cut at the ground level before flowering for recording the following:

Vegetative traits: Plant height (cm), fresh plant weight (g), dry plant weight (g), fresh and dry biomass yield (kg/fed) were calculated.

Leaves nutrient status: Stevia leaves samples were taken after 15 days from fertilizer treatments to determine leaves content of N P K and which collected from each treatments. Leaves were dried in a forced oven at 60°C till weight constant; ground to a fine powder then sub sample of 0.2 gm was wet digested using sulphuric-perchloric acid mixture (1:1) as described by **A.O.A.C (2000),** to determine nitrogen (%) by Kjeldahl method, potassium (%) using the flame photometer and total phosphorus (%) as described by **Jackson, (1967).**

Quality Traits

Quality traits of stevia in two field experiments were determined as follows

1.Stevioside % of dry stevia leaves (St %) was estimated using the method described by

A.O.A.C. (2000).

2.Rebaudioside A % of dry stevia leaves (Rb%) was estimated using the method described by **A.O.A.C. (2000).**

3. Stevioside yield of dry stevia leaves (St yield kg/fed) was calculated by the formula as follows:

$$\text{St yield(kg/fed} = \text{dry stevia leaves yield (kg /fed)} \times \text{Stevioside \%}$$

4. Rebaudioside A yield (Rb yield) of dry stevia leaves (kg/fed) was calculated by the formula as follows:

$\text{Rb yield(kg/fed)} = \text{dry stevia leaves yield (kg/ fed)} \times \text{Rebaudioside A\%}$ of dry leaves. Sweet

Glycosides extraction:

Stevia leaves were collected from different treatments at harvest then leaves were dried at 60^{O}C in hot air oven for 48 h. Hundred milligrams of leaves of stevia were macerated in methanol (10 ml) overnight and filtered and were re-extracted with same solvent twice (5ml each time) for 3 h each. The extractants were pooled together and concentrated up to dryness under reduced pressure. After defatting with n-hexane (2ml) thrice and vacuum drying, the extract was dissolved in 10 ml of high-performance liquid chromatography (HPLC) grade acetonitrile and water (80 :20) mobile phase degassed for 5 min. and filtered through 0.45 µm filter. The filtrated was used for HPLC analysis. Standard stock solutions (1mg/ 2ml) of standards of stevioside and Rebaudioside A contents were calculated through HPLC.

Competitive Relationships and Yield Advantages

LER: was calculated according to **(Willey and Roa 1980)** using the following formula:

LER = yab/ yaa + yba / ybb

Where:

Yaa = pure stand yield of species a (stevia). Ybb= pure stand yield of species b (Intercropping pattern crops).

Yab = mixture yield of a (when combined with b)

Yba = mixture yield of b (when combined with a).

MAI: Suggests that the economic assessment should be assessed on the basis of the rentable value of this land. MAI was calculated according to the formula suggested by **Willey and Rao (1980).**

MAI= value of combined intercrops×LER-1/LER

Farmer's benefit: It was calculated by determining the total costs and net return of Intercropping culture as compared to recommended solid planting of stevia as follows: Total return of Intercropping cultures = Price of stevia yield + price of Intercropping pattern yield. To calculate the total return, the average of stevia, maize, sunflower, wheat and faba bean prices presented by Agriculture Statistics (2019 and 2020) seasons was used.

Statistical Analysis

Data collected were subjected to Analysis of Variance (ANOVA). The proper statistical of all data was carried out according. Differences among treatments were evaluated by the least significant difference test (L.S.D.) according to the procedure outlined by **Gomez & Gomez (1984).** Significant differences were defined at 5 per cent level.

Results and Discussions

Stevia Vegetative Growth Characters

A-Effect of Intercropping patterns on Plant growth parameters of stevia plants:

The results in **Table (3&4)** indicated that Intercropping pattern significantly affected the five traits (plant height, fresh, dry weight or yield) in both seasons. Intercropping stevia with 50% of wheat surpassed the other four Intercropping patterns; stevia with 50% of sunflower, 50% of maize, between Intercropping and 50% of faba bean, while surpassed the sole by 19.92 % in plant height, by 4.07% in fresh plant weight, by 33.46% in fresh biomass yield, by 1.44 % in dry plant weight (g) and by 31.5 % in dry biomass yield kg/fed in the 1st and 2nd seasons, respectively. The same trend in 2nd season was recorded for these Intercropping patterns. Similar data was recorded with those reported by **Ramesh & Spaldin (2007)** who found that Intercropping stevia with wheat increased the stevioside content when compared to other intercrops. Similarly, **Lulie & Bogale (2014)** reported that there was nonsignificant yield variation of sole planting of haricot and intercropping with stevia plants. **Ramesh & Spaldin (2007)** concluded that the benefits of Intercropping stevia with wheat are achieved only when the two crops do not compete for some resources. An extension of Intercropping in stevia can lead to increased stevia productivity, along with food grain production, yield advantage in Intercropping is achieved only when component crops do not compete for the same resources over the same time and space. To reduce competition for stevia during wheat cropping, maturing along with the emergence of stevia needs to be explored to increase St productivity by **Sharma & Kumar (2016)**

B- Effect of sources of fertilizers on plant growth parameters of stevia plants

Results presented of **Table (3&4)** reveal that these treatments affected significantly on the previous traits in both seasons. The results showed that the previous traits were increased by mixing Biofertilizers with compost then decreased values of these traits of stevia plants in both seasons with 100 % N level. This result might be due to that the release of nutrients from compost and their absorption by plants and remineralization of immobilized N require time, which has become imperative to sustain high nutrient supply for greater productivity. However, application of control (80 kg N fed^{-1}) treatment alone might meet the lower nutrient demand. Similar data was recorded with those reported by **Das et al., (2009) and Zaman et al., 2018), Khaled and Fawy (2011), Kumar et al., (2012 and 2013) and Youssef et al. (2021)** who indicated biomass yield of stevia increased with application of compost over control (without Biofertilizers or compost). Nitrogen has a functional role in cell division and elongation, contributing to increase plant height which intern leads to a positive effect on plant height. The combined application of nitrogenous fertilizers and effective microorganisms improved growth, yield and nutrient accumulation in stevia plants. Compost fertilizer enhance the yield components such as leaves and dry matter content of the plant though increasing the meristematic activity and stimulation of cell elongation in **plants (Youssef et al. 2021). Sharma & Kumar (2016)** where organic manure improved the root activity and enhanced the photosynthesis rate; ultimately, the biomass of stevia and the content of glycosides were increased but farmyard manure (FYM) application recorded higher marker compounds than inorganic fertilizers.

C- Interaction between Intercropping patterns and sources of fertilizers

Interactions between Intercropping patterns and treatments of sources of fertilizers recorded significance in both seasons for the previous traits were showed in **Tables (5&6).** Under all Intercropping patterns it is noticed that the treatment of 80% N mixed with Biofertilizers, and compost surpassed the other treatments in both seasons. The combined application of nitrogenous fertilizers and effective microorganisms improved growth, yield, and nutrient accumulation in stevia plants **(Youssef et al., 2021).**

Quality Parameters of Stevia

A- Effect of Intercropping pattern on quality parameters of stevia

Results in **Table (9)** indicated that the studied Intercropping patterns significantly affected N%, P%, K% in both seasons except stevioside, Rebaudioside A %, and N uptake fed^{-1} in both seasons. Stevia + 50 % faba bean recorded the highest values of N%, P%, K%, while the lowest values of these traits were obtained by stevia+50 % maize in both seasons, respectively. These results may be attributed to the crops make up replaced by Intercropping, where wheat and faba bean were loaded for heating in winter and Intercropping sunflowers and maize for shading in summer in addition to increasing the area. Similar results were observed by **(Eissa et al., 2017)**.

B-Effect of sources of fertilizers on quality parameters of stevia

Production of more dry leaf biomass with higher steviol glycosides (stevioside and

Rebaudioside A%) is the main criterion for quality. Results in Table (9) showed that application of sources of fertilizers increased gradually the values of these traits. Mixing biofertilizer with compost led to an increase in Rtevioside, Rebaudioside A %, of stevia leaves. The results showed that the stevioside, Rebaudioside A, N, P and K% as well as N uptake fed^{-1} were increased by adding 80% N and mixing biofertilizer with compost followed by treatments of stevia plants alone in both seasons. Such data confirmed the previous reports of **(Patil 2010) and (Mahmoud et al., 2009 Gao et al., 2020 and Mahmoud & Gad 2020), (Rashwan et al., 2017), (Rashwan, & Ferweez, 2017),** who indicated that production of leaf biomass along with higher steviol glycosides is the main criteria for quality. They reported that glycoside content in stevia was greater in those plants which was supplied with compost due to improved root activity and they added that Rebaudioside A% is responsible for sweetness in stevia leaves, so higher Rebaudioside is desirable and stevia crop give economically yield up to 4-5 years.

C- Interaction between Intercropping patterns and sources of fertilizers

The interactions between Intercropping patterns and sources of fertilizers significantly affected the previous traits in both seasons except stevioside, Rebaudioside A %, and N uptake fed-1 traits in both seasons. It was noticed from **Table (11)** that under Intercropping patterns, treatment 80% N mixed with biofertilizer, and compost recorded the maximum value of the previous traits followed by treatment 80% N with compost and surpassed the other treatments in both seasons. Higher nutrient uptake was attributed to addition biofertilizer and compost + (80 %RD) application **(Nasrin 2008 and Gatie & Mohsen 2020).** This finding is in harmony with **Hassanain et al. (2016)** was indicated that the higher content of nutrients in the stevia plant was attributed to the higher availability of nutrients at the root zone. These results are in harmony with the finding of **Mostafa (2019)** who indicated the positive relationship between increasing fertilizers rate and increased Rebaudioside content.

Soil Chemical Analyses

A-Effect of Intercropping Pattern on Soil Chemical Analyses

Results in **fig (1)** Show significant differences in soil N, P, K and organic matter (OM.) %. stocks. The highest value of these traits was observed by Intercropping pattern 100% stevia + 50% faba bean, meanwhile the lowest values of soil N, P, K mgkg^{-1} and OM.% were obtained by Intercropping pattern 100% stevia + 50% maize. These results reveal that legume, the component in the intercrops, had important role in the available soil contents that could increase soil carbon which may contribute to better soil structure **(Eissa et al., 2017).** It is important to mention that soil N stock of the rhizosphere of intercropped stevia roots was increased by increasing the plant density of legume component from 20 to 30% of the sole culture. Moreover, it is expected that the intercrops will alter the dynamics of organic matter turnover and the rate of nutrient cycling within the soil **(Ullah et al., 2016).** These results could be due to an increase in plant density of the intercropped faba bean of sole culture increased intra-specific competition between plants of legume component more than competition between plants of the intercrops that differed in their competitive ability for basic growth resources. Moreover, it is known that limited plant-available P is associated with a more horizontal root angle in bean, placing roots in surface soil where P can accumulate because it is highly immobile. These results are similar to those obtained by **(Eissa et al., 2017)** who noticed that the residual effect of the legume crops had positive effects on soil N, P and K nutrients and OM.%. These results reveal that legume, the component in the intercrops, had an important role in the available soil contents that could increase soil carbon which may contribute to better soil structure **(Gibson et al., 2006).**

B-Effect of sources of fertilizers on soil chemical analyses

The results show that soil N, P, K and OM.% stocks increased (P≤0.05) with adding sources of fertilizers from recommended dose, biofertilizer+80% N, Compost + 80% N and mixing biofertilizer with compost 80% N fed^{-1}. Application of 80% N and mixing biofertilizer with compost 80% N fed-1 gave the highest values of soil N, P, K and OM.% contents compared with the other treatments. These results may be due to an added in sources of fertilizers application which stabilize organic matter and retard the mineralization of older soil organic matter **(Hagedorn et al., 2003)**. Accordingly, the other treatments influenced strongly soil OM.% and led to an environmental imbalance between soil biological and chemical processes reflected on action exchange capacity. **Zaman et al., (2017)** addition that organic fertilizers increased the organic carbon content of degraded soil which may lead to the increasing activity of beneficial soil microorganisms as well as the fertility status of soil by increasing the availability of nutrients for the plants from soil. It significantly increased the growth and yield of plants.

C- Interaction between Intercropping patterns and sources of fertilizers

Soil N, P, K and OM.% stocks of the rhizosphere of wheat roots were significantly affected by the interaction between mineral N fertilizer levels and Intercropping patterns in the combined data across the two seasons **(Table 10)**. Intercropping pattern 100% stevia + 50% faba bean with the application of mixing biofertilizer + compost + 80 kg N fed^{-1} had the highest values of soil N, P, K and OM.%, meanwhile the lowest values of soil chemical properties were obtained by Intercropping pattern 100% stevia + 50% maize that received 80 kg N fed^{-1}. It is expected that the intercrops will alter the dynamics of organic matter turnover and the rate of nutrient cycling within the soil **(Ullah et al., 2016)**. These results could be due to an increase in plant density of the intercropped faba bean of sole culture increased intra-specific competition between plants of legume component more than competition between plants of the intercrops that differed in their competitive ability for basic growth resources. Moreover, it is known that limited plant-available P is associated with a more horizontal root angle in bean, placing roots in surface soil where P can accumulate because it is highly immobile. These results are similar to those obtained by **Abdel-Wahab and Manzlawy (2016)** who noticed that the residual effect of the legume crops had positive effects on soil N, P and K nutrients. Similar data was recorded with those reported by **Ramesh & Spaldin (2007)** found that Intercropping stevia with wheat increased the stevioside content when compared to other intercrops. Due to the dual benefits obtained from this Intercropping and no significant yield variation of sole and intercropped treatments of the main crop, planting haricot bean with stevia mix proportion is advisable than sole planting of haricot bean, **Lulie & Bogale (2014).**

Competitive Relationships

Land Equivalent Ratio (LER)

Data presented in **Tables (11&12)** clearly indicated that LER in all treatments of the interaction between intercropped stevia and fertilization were greater than one in both seasons, with few exceptions indicating the advantageous to grow stevia with each of sunflower, maize and faba bean, wheat in association than in solid culture. Intercropping stevia with faba bean and using mixing biofertilizer + compost plus 80 % mineral N fertilizer recorded the highest values for (LER) which was (1.99&1,98) immediately followed by Intercropping wheat also three harvesting (1.88 & 1.87) in 1st and 2nd seasons, respectively. Higher LER in Intercropping treatments compared to mono cropping was attributed to better utilization of natural (land, CO_2 and light) and added (fertilizer and water) resources. Higher LER in Intercropping compared to monocropping of maize, sorghum, rice, corn mint, faba bean were also reported by **Takim (2012), Egbe (2010), Abdul et al. (2009), Abera and Daba (2008)** who found that LER values were greater with Intercropping system than sole crop of them. The result is in line to the previous study in grass-legume Intercropping systems **(Mahapatra, 2011).**

Total Returns and MAI

The data of economic analysis as influenced by Intercropping pattern and source fertilization compared with solid planting of both crops are presented in Table (11&12). It reveals that the net profit of using mixing biofertilizer + compost plus 80 kg mineral N fertilizer for stevia and wheat intercrop recorded 651.075 &691.403 L.E. fed. While the MAI recorded 650.543&690.868 L.E. fed, meanwhile, the lowest net return was recorded for Intercropping sunflower with stevia received rate of recommended dose mineral fertilizer 416.918 & 470.047 L.E. fed and MAI of 416.918 & 469.406 L.E. fed in the 1st and 2nd successive seasons respectively.

Conclusion

From the investigation, it appeared that Intercropping patterns and mixing Biofertilizers + compost + 80 kg N fed^{-1}gave significant positive response towards all the parameters studied. The best Intercropping pattern were Intercropping wheat in winter season and Intercropping maize in summer season, this is due to the length of the crop stay with stevia plants for heating in winter and for shading in summer in addition to increasing the yield per fed. Conclude was Intercropping pattern 100% stevia + 50% wheat with the application of mixing Biofertilizers + Compost + 80 kg N fed-1 for most the parameters. while post-harvest soil status the highest values were obtained from Intercropping pattern 100% stevia + 50% faba bean with the application of mixing Biofertilizers + Compost + 80 kg N fed-1. Finally, it would be recommended for the farmers under Minia Governorate conditions.

Conflicts of Interest/ Competing interest

All authors declare that they have no conflicts of interest.

Data availability statement

All data sets collected and analyzed during the current study are available from the corresponding author on reasonable request.

List of Abbreviations

ANOVA	Analysis of Variance
HPLC	High-performance liquid chromatography
L.S.D.	Least significant difference
LER	Land Equivalent Ratio
MAI	Monetary advantage index
RD	Recommended fertilization dosages

References

A.O.A.C (2000). Official Methods of Analysis Association of Official Agricultural Chemists 14th Benjamin Franklin Station, *Washington D.C.U.S.A.* pp. 490-51.

Abdul, J., Riaz, A., Bhatti, I. H., Virk, Z. A., & Khan, M. M. (2009). Assessment of yield advantages, competitiveness and economic benefits of diversified direct-seeded upland rice-based intercropping systems under strip geometry of planting. *Pakistan Journal of Agricultural Sciences*, 46(2), 96-101.

Abera, T., & Daba, F. (2008). Faba bean and field pea seed proportion for intercropping system in Horro Highlands of Western Ethiopia. *African Crop Science Journal*, *16*(4) 243-249.

Agricultural Statistics (2019-2020). Winter crops Agric. Sta. and Economic sector, Ministry of Agric. and land Reclamation, Egypt.

Das, K. R., R. Dang, T. N. Shivananda, & N. Sekerogla (2007). Influence of bio-fertilizers on the biomass yield and nutrient content in *Stevia rebaudiana* Bert grown in Indian subtropics. *J. of Medicinal Plants Res.* 1(1). 5-8.

Das, K. R., R. Dang, T.N. Shivananda, & N. Sekerogla (2009). Effect of biofertilizers on the nutrient avalability in soil in relation to growth, yield and yield attributes of *Stevia rebaudiana. Archives of Agronomy and soil Sci.*,55:359-366.

Ding, X., Han, X., Liang, Y., Qiao, Y., Li, L., & Li, N. (2012). Changes in soil organic carbon pools after 10 years of continuous manuring combined with chemical fertilizer in a Mollisol in China. *Soil and Tillage Research, 122, 36-41.*

Egbe, O.M. (2010). Effects of plant density of intercropped soybean with tall sorghum on competitive ability of soybean and economic yield at Otobi, Benue State, Nigeria. *J. cereals and oil seeds*, 1(1).1-10

Eissa, N. M. A., Rashwan, B. R. A., & Abozaed, S. H. (2017). Influences of intercropping two legume crops and mineral nitrogen fertilizer on wheat yield and micro–organisms activity in the rhizopsphere soil. *Egyptian Journal of Agricultural Sciences*, 68(1), 59-77.

Gao, C., El-Sawah, A. M., Ali, D. F. I., Alhaj Hamoud, Y., Shaghaleh, H., & Sheteiwy, M. S. (2020). The integration of bio and organic fertilizers improve plant growth, grain yield, quality and metabolism of hybrid maize (*Zea mays* L.). *Agronomy*, 10(3), 319.

Gatie, K. D., Ali, H. A., & Mohsen, K. H. (2020). Yield and quality of stevia (*Stevia rebaudiana* Bretoni) influenced by different nitrogen and potassium levels. https://faculty.uobasrah.edu.iq/uploads/publications/1631037452.pdf

Gibson, L., Singer, J., Barnhart, S., & Blaser, B. (2006). Intercropping winter cereal grains and red clover. *Agronomy Files 2&3. Iowa State Iniversity, University Extention. https://store.extension.iastate.edu/Product/Intercropping-Winter-Cereal-Grains-and-Red-Clover-pdf*

Gomez, K. A. & Gomez, A. A., (1984). Statistical Procedures for Agricultural Research (Second Edition.) John Wiley&Sons, *Inc.*,

Hagedorn, F., Spinnler, D., & Siegwolf, R. (2003). Increased N deposition retards mineralization of old soil organic matter. *Soil Biology and Biochemistry*, *35*(12), 1683-1692.

Hassanain, A.M, Amira R. Osman, Eman Sewedan, & Shimaa Kotb (2016). Effects of nitrogen fertilizer, humic acid foliar spraying and their interactions on stevia (*Stevia rebaudiana* L.) Under reclaimed soil conditions in Egypt. *J.Agri.&Env., Sci. Dam.Univ.,Egyp.*15 (1),1-31.

Huffaker, R. C., & Peterson, L. W. (1974). Protein turnover in plants and possible means of its regulation. *Annual Review of Plant Physiology*, 25(1), 363-392.

Jackson, M. L. (1967). Soil chemical analysis prentice Hall. *Inc.*, *Englewood Cliffs, NJ*, *498*, 183-204.

Khaled, H., & Fawy, H. A. (2011). Effect of different levels of humic acids on the nutrient content, plant growth, and soil properties under conditions of salinity. *Soil and Water Research*, *6*(1), 21-29.

***Khiraoui*, A., Bakha, M., Amchra, F., Ourouadi, S., Boulli, A., Al-Faiz, C., & Hasib, A. (2017).** Nutritional and biochemical properties of natural sweeteners of six cultivars of *Stevia rebaudiana* Bertoni leaves grown in Morocco. *Journal of Materials and Environmental Science*, *8*(3), 1015-1022.

Kumar, R., Sharma, S., & Prasad, R. (2013). Yield, nutrient uptake, and quality of stevia as affected by organic sources of nutrient. *Communications in soil science and plant analysis*, *44*(21), 3137-3149.

Kumar, R., Sharma, S., & Sood, S. (2014). Yield components, light interception and marker compound accumulation of stevia (*Stevia rebaudiana* Bertoni) affected by planting material and plant density under western Himalayan conditions. *Archives of Agronomy and Soil Science*, *60*(12), 1731-1745.

Kumar, R., Sharma, S., Ramesh, K., Prasad, R., Pathania, V. L., Singh, B., & Singh, R. D. (2012). Effect of agro-techniques on the performance of natural sweetener plant–stevia (*Stevia rebaudiana*) under western Himalayan conditions. *Indian Journal of Agronomy*, *57*(1), 74-81.

Kumari, A., Kumar, V., & Malhotra, N. (2021). *Stevia rebaudiana*. *In Himalayan Medicinal Plants (pp. 199-221). Academic Press*.

Lulie, B., & Bogale, T. (2014). Intercropping of Haricot bean (*Phaseolus vulgaris* L.) with stevia (*Stevia rebaudina* L.) as supplementary income generation at Wondo Genet Agricultural Research Center, South Ethiopia. *International Journal of Recent Research in Life Sciences,* 1(1), 44-54.

Mahapatra, S. C. (2011). Study of grass-legume intercropping system in terms of competition indices and monetary advantage index under acid lateritic soil of India. *American Journal of Experimental Agriculture*, *1*(1), 1.

Mahmoud, E., Abd EL-Kader, N., Robin, P., Akkal-Corfini, N., & Abd El-Rahman, L. (2009). Effects of different organic and inorganic fertilizers on cucumber yield and some soil properties. *World Journal of Agricultural Sciences*, *5*(4), 408-414.

Mahmoud, S. O., & Gad, D. A. M. (2020). Effect of vermicompost as fertilizer on growth, yield and quality of bean plants (*Phaseolus vulgaris* L.). *Middle East Journal of Agriculture Research*, *9*(1), 220-226.

Megeji, N. W., Kumar, J. K., Singh, V., Kaul, V. K., & Ahuja, P. S. (2005). Introducing *Stevia rebaudiana*, a natural zero-calorie sweetener. *Current science*, 801-804.

Mostafa, H. S. (2019). Impact of NPK fertilization and lithovit rates on growth, yield components and chemical constituents of *Stevia rebaudiana* Bert. Plant. *Middle East Journal of Applied Sciences*, *9*(2), 412-420.

Nasrin, D. (2008). Effect of nitrogen on the growth, yield and nutrient uptake by stevia (Doctoral dissertation, MS Thesis, Department of Agricultural Chemistry, Bangladesh Agricultural University, Mymensingh).

Oldfield, E. E., Bradford, M. A., & Wood, S. A. (2019). Global meta-analysis of the relationship between soil organic matter and crop yields. *Soil,* 5(1), 15-32.

Patil, N. M. (2010). Biofertilizer effect on growth, protein and carbohydrate content in *Stevia rebaudiana* Var Bertoni. *Recent Research in Science and Technology*, *2*(10), 42-44.

Peteliuk, V., Rybchuk, L., Bayliak, M., Storey, K. B., & Lushchak, O. (2021). Natural sweetener Stevia rebaudiana: Functionalities, health benefits and potential risks. *EXCLI journal*, 20, 1412.

Ramesh, K., Singh, V., & Ahuja, P. S. (2007). Production potential of *Stevia rebaudiana* (Bert.) Bertoni. under intercropping systems. *Archives of Agronomy and Soil Science*, *53*(4), 443-458.

Ramesh, R., & Spaldin, N. A. (2007). Multiferroics: progress and prospects in thin films. *Nature materials*, 6(1), 21-29.

Rashwan, B. R., Abd-El Raouf, R. M., Ahmed, N. R., & Ferweez, H. (2017). Efficacy of K-Humate, compost and biofertilizer application as well as cutting number on yield and quality of stevia (*Stevia rebaudiana* Bertoni) as natural sweetener. *Assiut Journal of Agricultural Sciences*, *48*(1), 251-268.

Rashwan, B., & Ferweez, H. (2017). Effect of mineral nitrogen fertilization and compost on stevia yield and its profitability. *Journal of Soil Sciences and Agricultural Engineering*, *8*(6), 215-222.

Ribeiro, M. M., Diamantino, T., Domingues, J., Montanari, Í., Alves, M. N., & Gonçalves, J. C. (2021). Stevia rebaudiana germplasm characterization using microsatellite markers and steviol glycosides quantification by HPLC. *Molecular biology reports*, 48(3), 2573-2582.

Sedlacek, C., Giguere, A., & Pjevac, P. (2020). Is too much fertilizer a problem. *Front. Young Minds*, *8* (63): 1-5.

Sharma, S., Walia, S., Singh, B., & Kumar, R. (2016). Comprehensive review on agro technologies of low-calorie natural sweetener stevia (*Stevia rebaudiana* Bertoni): a boon to diabetic patients. *Journal of the Science of Food and Agriculture*, *96*(6), 1867-1879.

Ding, E. S. Z. N. P., Li, L. L., Yuan, J. H., Che, Z. X., Zhou, H. Y., & Shang, L. G. (2018). Relationship of crop yield and soil organic carbon and nitrogen under long-term fertilization in black loessial soil region on the Loess Plateau in China. *Yingyong Shengtai Xuebao*, *29*(12).

Takim, F. O. (2012). Advantages of maize-cowpea intercropping over sole cropping through competition indices. *Journal of Agriculture and Biodiversity Research*, *1*(4), 53-59.

Abdel-Wahab, T. I., & Manzlawy, A. M. (2016). Yield and quality of intercropped wheat with faba bean under different wheat plant densities and slow-release nitrogen fertilizer rates in sandy soil. *American Journal of Experimental Agriculture, 11(6), 1-22.*

Ullah, M. A., Hussain, N., Schmeisky, H., & Rasheed, M. (2016). Enhancing Soil Fertility through Intercropping, Inoculation and Fertilizer: Grass and Legumes Intercropping for Soil Fertility. *Biological Sciences-PJSIR, 59(1), 1-5.*

Willey, R., & Rao, M. (1980). A competitive ratio for quantifying competition between intercrops. *Experimental agriculture*, *16*(2), 117-125.

Yaday, A. K., Singh, S., Dhyani, D., & Ahuja, P. S. (2011). A review on the improvement of stevia [*Stevia rebaudiana* (Bertoni)]. *Canadian journal of plant science, 91(1), 1-27.*

Youssef, M. A., Yousef, A. F., Ali, M. M., Ahmed, A. I., Lamlom, S. F., Strobel, W. R., & Kalaji, H. M. (2021). Exogenously applied nitrogenous fertilizers and effective microorganisms improve plant growth of stevia (*Stevia rebaudiana Bertoni)* and soil fertility. *AMB Express, 11(1), 1-10.*

Zaman, M. M., Chowdhury, T., Nahar, K., & Chowdhury, M. A. H. (2017). Effect of cow dung as organic manure on the growth, leaf biomass yield of Stevia rebaudiana and post-harvest soil fertility. *Journal of the Bangladesh Agricultural University*, *15*(2), 206-211.

Zaman, M. M., Nahar, K., Chowdhury, T., & Chowdhury, M. A. H. (2017). Growth, leaf biomass yield of stevia and post-harvest soil fertility as influenced by different levels of poultry manure. *Journal of the Bangladesh Agricultural University*, *15*(2), 212-218.

Zaman, M. M., Rahman, M. A., Chowdhury, T., & Chowdhury, M. A. H. (2018). Effects of combined application of chemical fertilizer and vermicompost on soil fertility, leaf yield and stevioside content of stevia. *Journal of the Bangladesh Agricultural University*, *16*(1), 73-81.

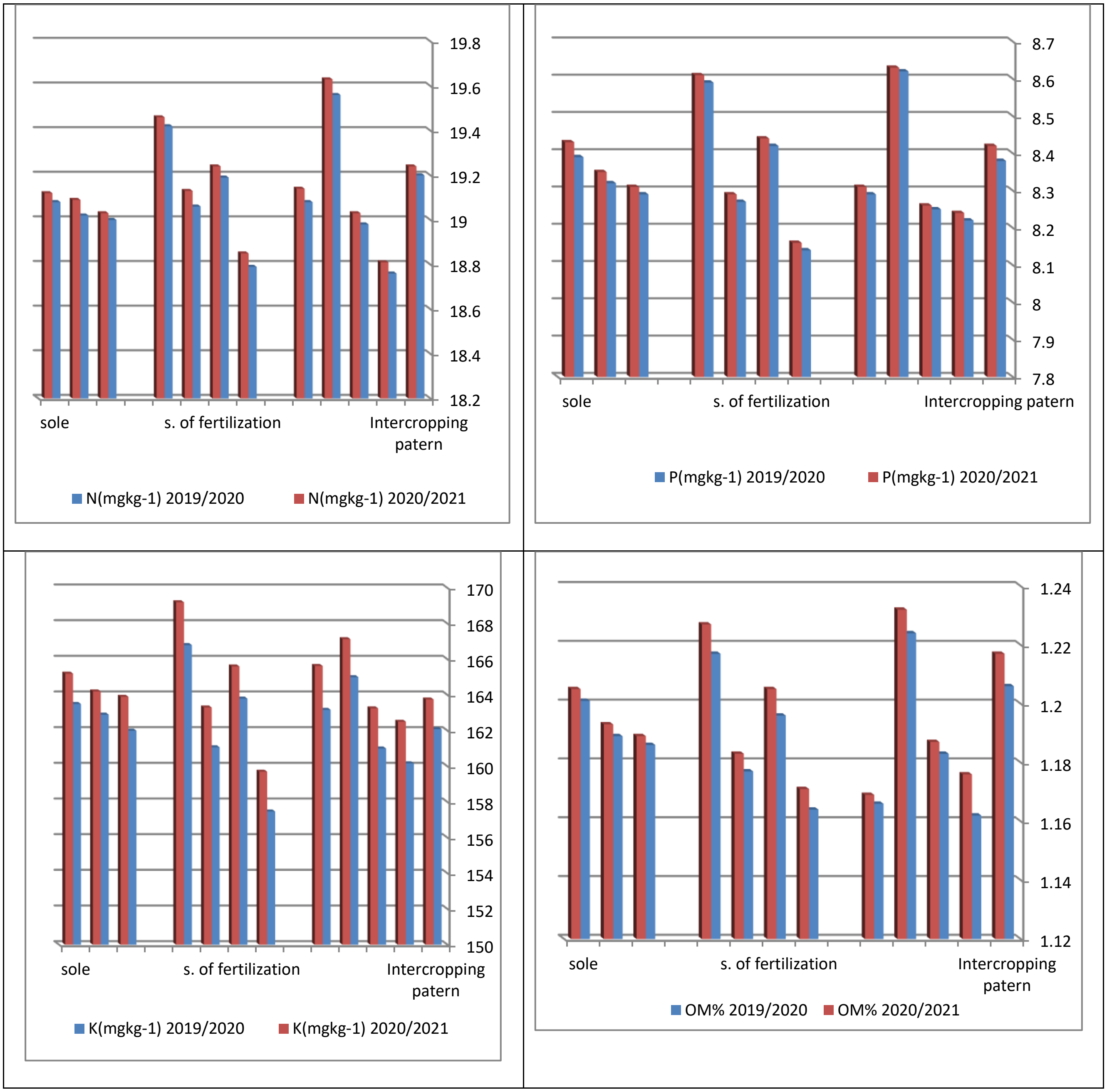

Fig 1: Effect of Intercropping pattern and sources of fertilizers on Soil chemical analyses

Table 1a: Details of the events of the experiment.

Particulars Date No. of days	
Year 2019 – 2020	**Year 2020 – 2021**
Sowing of sunflower and maize 05.05.2019	Sowing of sunflower and maize 01.05.2020
Planting of *Stevia rebaudiana* 25.05.2019	Planting of *S. rebaudiana* 20.05.2020
-First harvest of *S. rebaudiana* 24.08.2019 90	First harvest of *S. rebaudiana* 19.08.2020 90
Harvest of sunflower 03.08.2019	Harvest of sunflower 28.08.2020
Harvest of maize 23.08.2019	Harvest of maize 21.09.2020
-Second harvest of *S. rebaudiana* 14.10.2019 140	Second harvest of *S. rebaudiana* 10.10.2020 140
Sowing of wheat and faba bean 25.11.2019	Sowing of wheat and faba bean 20.11.2020
Harvest of faba bean 14.04.2020	Harvest of intercrops 30.04.2021
Harvest of wheat 04.05.2020	Third harvest of *S. rebaudiana* 02.05.2021 190
-Third harvest of *S. rebaudiana* 01.05.2020 190	

Table 1b: Average monthly meteorological data of Minia weather station during the two growth seasons of 2019/2020 and 2020/2021

Parameter	2019				2020			
Month	**Temperature (°C)**		**Relative Humidity %**	**Wind speed (km/h)**	**Temperature (°C)**		**Relative Humidity %**	**Wind speed (km/h)**
	Max	**Min**			**Max**	**Min**		
April	29.2	11.8	51.5	4.1	30.2	12.3	52.5	4.0
May	37.3	17.5	36.4	4.1	38.1	17.9	39.2	4.2
June	38.0	22.0	40.8	4.6	40.2	22.9	45.2	5.2
July	37.1	22.3	50.6	4.2	39.5	23.2	51.8	4.6
August	37.3	22.0	52.2	3.5	40.6	25.1	50.2	4.1
September	34.4	20.4	59.7	4.3	36.4	21.4	53.7	4.8
October	32.8	17.1	60.5	3.3	23.1	18.3	57.2	4.0
November	28.1	12.2	69.8	2.5	29.2	14.2	59.2	3.3
December	21.8	7.00	76.3	2.4	22.1	7.00	77.3	2.9

Table 2a: Some physical and chemical properties of the experimental soil.

Properties	**2019/2020**	**2020/2021**
Particle size distribution (%)		
Sand (%)	8.03	8.11
Silt (%)	53.54	52.91
Clay (%)	38.43	38.98
Soil texture	Silty clay loam	
Organic matter (%)	1.14	1.15
pH soil – water suspension ratio (1:2.5)	8.20	8.15
EC (dsm^{-1}) soil-water extract ratio (1:5)	1.24	1.26
Soluble cations (meq/L)		
Ca^{++}	7.35	7.15
Mg^{++}	2.13	2.16
Na^{+}	3.21	3.43
K+	0.20	0.25
Soluble anions (meq/L)		
CO_3^{--}	---	
HCO^{-}	3.20	3.44
Cl^{-}	4.14	4.08
SO_4^{--}	5.55	5.47
Available nutrients (mg kg^{-1})		
Available N (ppm)	18.20	18.31
Available P (ppm)	7.67	7.71
Available K (ppm)	155.50	155.82

Table 2b: Some characteristics of composted crop residues (CCR)

Properties	OM (%)	Organic carbon (%)	pH soil – water suspension ratio (1:10)	E.C soil- water extract (1:10).(dS/m\1)	C: N	Total macronutrients (%)			Total micronutrients (ppm)			Weight of one m^3 (kg)
						N	P	K	Zn	Fe	Mn	
Values	32.75	19.25	7.85	6.9	11.6:1	0.87	0.22	0.85	54	810	204	450

Table3: Effect of Intercropping pattern and sources of fertilization on plant height cm, fresh plant weight (g), fresh biomass yield (kg /fed)

Treatments	Characters	Plant height (cm)		Fresh plant weight (g)		Fresh biomass yield (kg /fed)					
	No. of harvest	2019/2020	2020/2021	2019/2020	2020/2021	2019/2020			2020/2021		
						Leaf	Stem	Total	Leaf	Stem	Total
Stevia+50% Sunflower	First harvest	44.15	74.68	608.99	631.36	6162.82	3090.13	9252.95	4991.59	3384.06	8375.65
Stevia + 50% Maize		48.82	79.53	613.13	639.67	6186.63	3254.35	9440.98	4994.73	3412.41	8407.14
Between Intercropping	Second harvest	53.36	77.15	644.74	668.45	6950.55	4012.83	10963.38	5523.45	4151.65	9675.10
Stevia+ 50% Faba bean	Third harvest	70.70	88.24	677.08	699.40	7278. 98	4743.64	12022.62	6209.21	5014.74	11223.95
Stevia + 50% Wheat		75.55	91.88	681.64	703.03	7295.17	4747.97	12043.14	6288.70	5009.44	11298.14
L.S.D 5 %		1.11	0.57	4.43	3.19	99.74	61.63	129.54	44.17	17.67	63.95
Recommended dose (100%N)		53.71	78.99	628.79	652.44	6559.27	3937.96	10497.23	5433.24	4002.03	9435.27
Compost+80% RD		58.08	83.53	650.13	673.26	6903.08	3999.46	10902.54	5618.04	4180.31	9798.35
Biofertilizer + 80% RD		57.16	80.79	634.09	661.30	6620.84	3839.25	10460.09	5464.15	4053.74	9517.90
Mixture Biofertilizer +Compost + 80% RD		65.11	85.85	667.46	686.53	7023.33	4102.48	11125.81	5890.69	4541.75	10432.45
L.S.D $_{5\%}$		0.57	0.54	2.66	2.13	56.02	37.67	90.67	45.42	38.41	78.29
Sole Stevia	First harvest	42	45	607.10	608.00	2681	2804	5485	2720	2980	5700
	Second harvest	52	56	612.20	614.00	3276	2984	6260	3578	3420	6998
	Third harvest	63	67	655.00	689.00	4534	4490	9024	4897	4650	9547

Table 4: Effect of Intercropping pattern and sources of fertilization on dry plant weight (g), dry biomass yield (kg /fed), Dry biomass yield (kg/fed)

	Characters	Dry plant weight (g)		Dry biomass yield (kg/fed)					
Treatments	No. of harvest	2019/2020	2020/2021	2019/2020			2020/2021		
				Leaf	Stem	Total	Leaf	Stem	Total
Stevia+50%Sunflower	First harvest	205.74	237.67	2017.24	1095.24	3112.48	1815.50	1639.53	3455.67
Stevia +50 % Maize		210.10	242.28	2018.27	1181.81	3200.08	1817.15	1648.07	3460.10
Between Intercropping	Second harvest	222.30	257.03	2108.24	1242.02	3350.26	1906.84	2087.48	3991.93
Stevia+50%Faba bean	Third harvest	247.27	274.12	2152.48	2205.31	4357.79	2048.32	2553.29	4593.78
Stevia + 50 % Wheat		251.57	280.27	2161.74	2201.30	4378.79	2325.81	2577.55	4649.99
L.S.D 5 %		0.95	1.33	11.56	40.25	46.46	15.82	27.47	27.41
Recommended dose (100%N)		217.74	246.19	2000.79	1518.12	3537.66	2067.60	2062.99	3916.14
Compost + 80% RD		228.38	264.50	2116.24	1603.99	3720.23	2148.84	2085.26	4034.11
Biofertilizer + 80% RD		220.64	248.35	2022.66	1542.15	3564.81	2063.29	2072.43	3955.71
Mixture Biofertilizer +Compost + 80% RD		242.81	274.29	2226.69	1636.08	3862.77	2231.16	2184.06	4215.21
L.S.D 5 %		0.93	0.98	17.82	24.20	31.28	18.67	35.14	39.00
Sole Stevia	First harvest	218.00	220.00	1765	1039	2804	1790	1110	2900
	Second harvest	232	239	1875	1109	2984	1975	1311	3286
	Third harvest	248	256	2105	1225	3330	2015	1420	3435

Table 5: Effect of interactions between Intercropping pattern and sources of fertilization on plant height, fresh plant weight g, fresh biomass yield kg/fed.

Intercropping Crops	Fertilizer	Plant height (cm)		Fresh plant weight (g)		Fresh biomass yield (kg /fed)					
						2019/2020			2020/2021		
		2019/2020	**2020/2021**	**2019/2020**	**2020/2021**	Leaf	Stem	Total	Leaf	Stem	Total
Stevia+ Sunflower	Recommended dose (100%N)	40.33	69.87	587.65	600.43	5780.96	3010.22	8791.18	4922.67	3110.88	8033.55
	Compost + 80% RD	45.36	76.94	610.99	644.68	6471.32	3219.99	9691.31	5011.90	3361.02	8372.92
	Biofertilizer + 80% RD	43.52	72.90	591.66	622.75	5870.32	3041.66	8911.98	4961.09	3248.23	8209.32
	Mixture Biofertilizer + Compost+ 80% RD	47.39	79.01	645.66	657.56	6528.66	3088.66	9617.32	5070.68	3816.09	8886.77
Stevia+ Maize	Recommended dose (100%N)	46.56	75.88	591.80	620.33	5863.79	3654.66	9518.45	4921.89	3210.94	8132.83
	Compost + 80% RD	49.50	80.16	615.13	647.89	6475.47	3892.80	10368.27	5015.11	3364.23	8379.34
	Biofertilizer + 80% RD	47.67	77.43	595.80	627.29	5874.47	3045.80	8920.27	4965.62	3252.77	8218.39
	Mixture Biofertilizer + Compost+ 80% RD	51.53	84.63	649.80	663.18	6532.80	3224.13	9756.93	5076.30	3821.72	8898.02
Between inter.	Recommended dose (100%N)	45.89	75.23	630.32	660.43	6930.23	3654.34	10584.57	5321.78	4023.56	9345.34
	Compost + 80% RD	46.01	76.37	647.21	672.23	6935.21	4235.45	11170.66	5535.70	4185.90	9721.60
	Biofertilizer + 80% RD	55.21	77.51	635.77	664.70	7055.12	3662.88	10718.00	5357.76	4079.43	9437.19
	Mixture Biofertilizer + Compost+ 80% RD	66.32	79.48	665.65	676.43	6881.65	4498.65	11380.31	5878.56	4317.70	10196.26
Stevia+ Faba bean	Recommended dose (100%N)	65.43	85.43	665.23	690.45	7132.31	4683.89	11816.20	5923.99	4843.11	10767.10
	Compost + 80% RD	71.48	90.92	675.88	699.58	7314.99	4692.32	12007.32	6262.58	4994.01	11256.60
	Biofertilizer + 80% RD	67.99	86.24	670.32	692.57	7149.88	4750.14	11900.02	5939.01	4847.90	10786.92
	Mixture Biofertilizer + Compost+ 80% RD	77.88	90.35	696.88	715.01	7583.48	4848.21	12431.69	6711.24	5373.92	12085.15
Stevia+ Wheat	Recommended dose (100%N)	70.34	88.56	668.93	690.54	7089.06	4686.66	11775.72	6075.89	4821.67	10897.56
	Compost + 80% RD	78.04	93.27	701.41	701.93	7318.42	4756.71	12075.13	6264.93	4996.37	11261.30
	Biofertilizer + 80% RD	71.42	89.88	676.88	699.21	7154.41	4695.76	11850.17	6097.29	4840.36	10937.65
	Mixture Biofertilizer + Compost+ 80% RD	82.41	95.79	679.32	720.45	7590.04	4852.74	12442.78	6716.67	5379.35	12096.02
L.S.D 5 %		1.27	1.199	5.945	4.762	125.27	84.23	207.43	101.57	85.879	178.65

Table 6: Effect of interactions between Intercropping pattern and sources of fertilization on dry plant weight (g), dry biomass yield and dry biomass yield (kg/fed).

Intercropping Crops	Fertilizer	Dry plant weight (g)		Dry biomass yield (kg /fed)			Intercropping		Dry biomass yield (kg /fed)			Intercropping	
		2019/ 2020	2020/ 2021	2019/2020					2020/2021				
				Leaf	Stem	Total	Yield/fed	Straw/fed	Leaf	Stem	Total	Yield/fed	Straw/fed
Stevia+ Sunflower	Recommended dose (100%N)	195.32	224.67	1965.32	1044.65	3009.97	515.00	-	1772.65	1579.45	3352.10	516.67	-
	Compost + 80% RD	208.99	243.35	2024.66	1115.32	3139.98	666.67	-	1809.56	1603.68	3413.25	700.00	-
	Biofertilizer + 80% RD	197.32	227.42	1971.99	1059.66	3031.65	595.00	-	1781.75	1597.90	3379.65	601.67	-
	Mixture Biofert. +Compost + 80% RD	221.32	255.23	2106.99	1161.32	3268.32	765.00	-	1898.02	1777.09	3675.10	756.67	-
Stevia+ Maize	Recommended dose (100%N)	200.32	229.76	1957.00	111.99	3032.76	11.00	-	1765.89	1600.21	3366.1	12.00	-
	Compost + 80% RD	213.13	246.56	2028.80	1130.31	3159.11	13.00		1812.77	1606.89	3419.66	14.33	-
	Biofertilizer + 80% RD	201.47	231.96	1976.13	1119.47	3095.60	10.00	-	1786.29	1602.44	3388.73	11.33	-
	Mixture Biofert.+ Compost + 80% RD	225.47	260.85	2111.13	1165.47	3276.60	14.00	-	1903.64	1782.72	3686.36	15.00	-
Between inter.	Recommended dose (100%N)	210.87	241.76	2012.65	1156.43	3169.08	-	-	1832.99	2100.21	3933.20	-	-
	Compost + 80% RD	225.45	270.43	2110.99	1294.12	3405.11	-	-	1950.37	2090.90	4041.27	-	-
	Biofertilizer + 80% RD	212.54	245.37	2031.54	1196.21	3227.75	-	-	1865.76	2109.37	3975.13	-	-
	Mixture Biofert. + Compost + 80% RD	240.32	270.56	2277.79	1321.32	3599.11	-	-	1978.23	2049.43	4027.66	-	-
Stevia+ Faba bean	Recommended dose (100%N)	239.76	262.63	2023.21	2154.55	4177.76	5.00	1.17	1954.78	2500.32	4455.10	4.73	1.08
	Compost + 80% RD	245.44	279.90	2206.66	2236.81	4443.47	5.87	1.33	2084.58	2561.24	4645.82	5.93	1.30
	Biofertilizer + 80% RD	242.65	264.25	2064.55	2165.99	4230.54	5.17	1.10	1968.68	2509.35	4478.03	4.73	1.22
	Mixture Biofert. + Compost + 80% RD	261.21	289.68	2315.48	2263.88	4579.36	6.77	1.43	2185.24	2642.25	4827.49	6.93	1.65
Stevia+ Wheat	Recommended dose (100%N)	242.44	272.12	2045.76	2123.98	4169.74	7.97	1.23	3011.67	2534.74	5546.41	7.73	1.18
	Compost + 80% RD	248.87	282.25	2210.09	2243.37	4453.46	8.70	1.47	3086.93	2563.59	5650.52	8.27	1.37
	Biofertilizer + 80% RD	249.22	272.77	2069.08	2169.42	4238.50	7.63	1.42	2913.96	2543.07	5457.03	7.87	1.35
	Mixture Biofert. + Compost + 80% RD	265.74	295.12	2322.04	2268.41	4590.45	9.60	1.91	3190.67	2668.79	5859.46	9.03	2.00
L.S.D 5 %	Stevia	2.12	2.08	39.84	54.10	90.83	-	-	1.91	78.57	118.02	-	-
	Sunflower						64.80					64.15	-
	Maize						1.73					1.45	-
	Faba bean						1.02	0.16				0.16	0.19
	Wheat						1.00	0.25				0.74	0.22

Table 7: Effect of Intercropping pattern and sources of fertilization on quality parameters of stevia.

Treatments	No of harvest	Stevioside%		Rebaudioside A%		N%		P%		K%		Uptake N	
		2019/ 2020	2020/ 2021	2019/ 2020	2020/ 2021	2019/ 2020	2020/ 2021	2019/ 2020	2020/ 2021	2019/ 2020	2020/ 2021	2019/ 2020	2020/ 2021
Stevia+ 50% Sunflower	First 1st	10.03	10.03	4.26	4.26	1.597	1.592	0.197	0.190	1.862	1.826	49.71	55.043
Stevia + 50 **% Maize**		9.87	9.85	4.10	4.08	1.548	1.545	0.190	0.189	1.736	1.730	48.67	53.62
Between Intercropping	Second 2nd	9.90	9.87	4.13	4.11	1.570	1.567	0.194	0.192	1.775	1.773	52.85	62.74
Stevia + 50 **% Faba** bean	Third 3rd	10.27	10.24	4.50	4.47	1.615	1.629	0.213	0.209	1.895	1.922	70.58	74.90
Stevia+50 % Wheat		9.91	9.89	4.14	4.12	1.604	1.592	0.208	0.202	1.876	1.879	70.29	74.06
L.S.D 5 %		NS	NS	NS	NS	0.0039	0.0036	0.0074	0.0065	0.0069	0.0059	NS	NS
Recommended dose (100%N)		9.79	9.77	4.02	4.00	1.504	1.503	0.182	0.179	1.589	1.589	53.37	59.05
Compost + 80% RD		10.07	10.05	4.30	4.28	1.612	1.611	0.203	0.199	1.902	1.897	60.07	65.14
Biofertilizer + 80% RD		9.90	9.90	4.13	4.12	1.589	1.584	0.196	0.191	1.840	1.839	56.71	62.80
Mixture Biofertilizer +Compost +80% RD		10.22	10.21	4.46	4.44	1.642	1.641	0.220	0.216	1.984	1.980	63.54	69.30
L.S.D 5 %		0.0202	0.221	0.085	0.089	0.0032	0.0029	0.0025	0.0023	0.0048	0.0043	NS	NS
Sole Stevia	First harvest	9.94	4.15	4.17	4.15	1.561	1.559	0.192	0.188	1.821	1.809	44.331	45.791
	Second harvest	9.97	4.19	4.2	4.19	1.572	1.565	0.195	0.193	1.841	1.838	47.386	52.083
	Third harvest	10.04	4.27	4.27	4.27	1.578	1.575	0.203	0.200	1.872	1.868	53.047	54.617

Table 8: Effect of Intercropping pattern and sources of fertilization on.N,P,K (mgkg^{-1}) and organic matter percentage in soil

Treatments		No. of harvest	N(mgkg^{-1})		P(mgkg^{-1})		K(mgkg^{-1})		OM%	
			2019/2020	2020/2021	2019/2020	2020/2021	2019/2020	2020/2021	2019/2020	2020/2021
Stevia+ 50% Sunflower		First 1st	19.20	19.24	8.38	8.42	162.09	163.75	1.206	1.217
Stevia + 50 **% Maize**			18.76	18.81	8.22	8.24	160.17	162.50	1.162	1.176
Between Intercropping		Second 2nd	18.98	19.03	8.25	8.26	161.00	163.25	1.183	1.187
Stevia **+ 50** % Faba bean		Third 3rd	19.56	19.63	8.62	8.63	165.00	167.13	1.224	1.232
Stevia+50 % Wheat			19.08	19.14	8.29	8.31	163.17	165.63	1.166	1.169
L.S.D 5 %			0.0664	0.0688	0.0179	0.0185	1.8990	1.9180	0.0117	0.0068
Recommended dose (100%N)			18.79	18.85	8.14	8.16	157.47	159.70	1.164	1.171
Compost + 80% RD			19.19	19.24	8.42	8.44	163.80	165.60	1.196	1.205
Biofertilizer + 80% RD			19.06	19.13	8.27	8.29	161.07	163.30	1.177	1.183
Mixture Biofertilizer +Compost +80% RD			19.42	19.46	8.59	8.61	166.80	169.20	1.217	1.227
L.S.D 5 %			0.0139	0.0142	0.0121	0.0129	0.4008	0.4012	0.0020	0.0026
Sole Stevia	First harvest		19.00	19.03	8.29	8.31	162.00	163.9	1.186	1.189
	Second harvest		19.02	19.09	8.32	8.35	162.9	164.2	1.189	1.193
	Third harvest		19.08	19.12	8.39	8.43	163.5	165.2	1.201	1.205

Table 9: Effect of interactions between Intercropping pattern and sources of fertilization on quality parameters of stevia

Intercropping Crops	Fertilizer	Stevioside%		Rebaudioside A%		N%		P%		K%		Uptake N	
		2019/ 2020	**2020/ 2021**	**2019/ 2020**	**2020/ 2021**	**2019/ 2020**	**2020/ 2021**	**2019/ 2020**	**2020/ 2021**	**2019/ 2020**	**2020/ 2021**	**2019/ 2020**	**2020/ 2021**
Stevia+ Sunflower	Recommended dose (100%N)	9.82	9.82	4.05	4.05	1.518	1.517	0.183	0.172	1.627	1.607	45.545	50.890
	Compost + 80% RD	10.04	10.02	4.27	4.25	1.622	1.617	0.198	0.193	1.940	1.900	50.930	55.192
	Biofertilizer + 80% RD	9.92	9.92	4.15	4.15	1.611	1.587	0.192	0.183	1.883	1.837	48.84	53.64
	Mixture Biofertilizer+Compost+80% RD	10.34	10.36	4.57	4.59	1.638	1.645	0.216	0.212	1.997	1.960	53.54	60.46
Stevia+ Maize	Recommended dose (100%N)	9.7	9.66	3.93	3.89	1.447	1.445	0.166	0.167	1.477	1.475	43.884	48.412
	Compost + 80% RD	9.92	9.91	4.15	4.14	1.577	1.574	0.204	0.198	1.807	1.804	49.819	53.928
	Biofertilizer + 80% RD	9.83	9.82	4.06	4.05	1.548	1.545	0.187	0.185	1.740	1.738	47.920	52.458
	Mixture Biofertilizer +Compost +80% RD	10.04	10.02	4.27	4.25	1.619	1.617	0.218	0.217	1.920	1.900	53.048	59.682
Between inter.	Recommended dose (100%N)	9.72	9.7	3.95	3.93	1.485	1.482	0.170	0.168	1.540	1.538	47.679	58.366
	Compost + 80% RD	9.93	9.91	4.16	4.14	1.597	1.594	0.193	0.195	1.850	1.847	54.380	64.539
	Biofertilizer + 80% RD	9.83	9.8	4.06	4.03	1.568	1.564	0.189	0.187	1.780	1.778	50.611	62.330
	Mixture Biofertilizer+Compost + 80% RD	10.11	10.09	4.34	4.32	1.632	1.629	0.209	0.206	1.930	1.928	58.737	65.731
Stevia+ Faba bean	Recommended dose (100%N)	9.93	9.91	4.16	4.14	1.542	1.556	0.204	0.198	1.657	1.680	64.956	68.834
	Compost + 80% RD	10.44	10.41	4.67	4.64	1.637	1.648	0.218	0.207	1.970	1.977	72.740	76.563
	Biofertilizer + 80% RD	10.11	10.09	4.34	4.32	1.610	1.627	0.198	0.204	1.900	1.930	68.112	72.858
	Mixture Biofertilizer +Compost + 80%RD	10.6	10.56	4.83	4.79	1.671	1.685	0.230	0.228	2.053	2.100	76.521	81.343
Stevia+ Wheat	Recommended dose (100%N)	9.76	9.74	3.99	3.97	1.530	1.517	0.188	0.189	1.643	1.640	64.761	68.765
	Compost + 80% RD	10.01	9.98	4.24	4.21	1.628	1.623	0.204	0.203	1.943	1.957	72.502	75.478
	Biofertilizer + 80% RD	9.82	9.82	4.05	4.05	1.606	1.596	0.212	0.196	1.897	1.910	68.070	72.730
	Mixture Biofertilizer +Compost + 80%RD	10.04	10.02	4.27	4.25	1.652	1.631	0.227	0.218	2.020	2.010	75.834	79.258
L.S.D 5 %		0.511	0.501	0.481	0.478	0.0075	0.0066	0.0053	0.0049	0.0102	0.0095	NS	NS
Sunflower		-	-	-	-	2.708	2.701	0.411	0.421	2.55	2.50	17.207	17.388
Maize		-	-	-	-	1.365	1.369	0.362	0.366	2.45	2.42	0.164	0.181
Faba bean		-	-	-	-	3.801	3.809	0.375	0.382	2.69	2.65	0.217	0.213
Wheat		-	-	-	-	1.451	1.462	0.399	0.405	2.52	2.56	0.123	0.113

Table 10: Effect of interactions between Intercropping pattern and sources of fertilization on N, P, K (mgkg^{-1}) and organic matter percentage in soil

Intercropping Crops	Fertilizer	N(mgkg$^{-1)}$		P(mgkg^{-1})		K(mgkg^{-1})		OM%	
		2019/ 2020	**2020/ 2021**	**2019/ 2020**	**2020/ 2021**	**2019 2020**	**2020/ 2021**	**2019/ 2020**	**2020/ 2021**
Stevia+ Sunflower	Recommended dose (100%N)	19.06	19.15	8.17	8.21	158.00	159.00	1.180	1.183
	Compost + 80% RD	19.25	19.27	8.39	8.41	162.67	164.00	1.217	1.235
	Biofertilizer + 80% RD	19.13	19.16	8.27	8.31	161.00	163.00	1.191	1.195
	Mixture Biofertilizer+Compost+80% RD	19.36	19.38	8.69	8.75	166.67	169.00	1.237	1.255
Stevia+ Maize	Recommended dose (100%N)	18.21	18.25	8.05	8.05	155.67	159.00	1.136	1.155
	Compost + 80% RD	18.95	19.02	8.27	8.30	163.00	164. 50	1.167	1.180
	Biofertilizer + 80% RD	18.78	18.86	8.18	8.21	158.00	159.50	1.157	1.170
	Mixture Biofertilizer+Compost+80% RD	19.10	19.12	8.39	8.41	164.00	167.00	1.187	1.200
Between inter.	Recommended dose (100%N)	18.63	18.68	8.07	8.09	157.00	159.50	1.158	1.159
	Compost + 80% RD	19.10	19.15	8.28	8.30	162.00	164.00	1.185	1.188
	Biofertilizer + 80% RD	18.96	19.00	8.18	8.19	160.00	162.50	1.176	1.178
	Mixture Biofertilizer+Compost+80% RD	19.23	19.28	8.46	8.48	165.00	167.00	1.215	1.223
Stevia+ Faba bean	Recommended dose (100%N)	19.17	19.22	8.28	8.30	159.00	161.00	1.202	1.211
	Compost + 80% RD	19.52	19.59	8.79	8.80	166.67	168.50	1.236	1.243
	Biofertilizer + 80% RD	19.38	19.47	8.46	8.48	163.67	166.50	1.207	1.214
	Mixture Biofertilizer+Compost+80% RD	20.17	20.22	8.95	8.95	170.67	172.50	1.253	1.262
Stevia+ Wheat	Recommended dose (100%N)	18.87	18.94	8.11	8.13	157.67	160.00	1.142	1.147
	Compost + 80% RD	19.13	19.17	8.36	8.37	164.67	167.00	1.174	1.177
	Biofertilizer + 80% RD	19.05	19.14	8.25	8.26	162.67	165.00	1.153	1.157
	Mixture Biofertilizer+Compost+80% RD	19.26	19.32	8.45	8.48	167.67	170.50	1.194	1.197
L.S.D 5 %		0.0309	0.0893	0.0292	0.0344	0.8960	0.7683	0.0043	0.0058
Sunflower		19.10	19.15	8.28	8.30	162.00	164.00	1.185	1.188
Maize		18.21	18.25	8.05	8.05	155.67	159.00	1.136	1.155
Between Intercropping		18.53	18.68	8.07	8.09	157.00	161.50	1.158	1.159
Faba bean		19.52	19.59	8.79	8.80	166.67	168.50	1.236	1.243
Wheat		18.78	18.86	8.18	8.21	163.00	161.50	1.157	1.170

Table 11: Effect of interactions between Intercropping pattern and sources of fertilization on LER, Total returns and MAI

Intercropping Crops	No of harvest	Fertilizer	Dry biomass yield (kg /fed)	Intercropping		LER = LERs + LER i			Total expense LE/fed	Net profit LE/fed	MAI
			Total stevia	Yield	Straw	LER S	LER i	LER			
Stevia+ Sunflower	First 1st	2019 / 2020									
		Recommended dose (100%N)	3000.32	515.00	-	1.07	0.41	1.48	454.168	416.918	416.242
		Compost + 80% RD	3139.98	666.67	-	1.12	0.53	1.65	476.330	439.08	438.474
		Biofertilizer + 80% RD	3031.65	595.00	-	1.08	0.48	1.56	459.508	422.258	421.617
		Mixture Biofertilizer +Compost+ 80% RD	3268.32	765.00	-	1.17	0.61	1.78	496.368	459.118	458.556
Stevia+Maize		Recommended dose (100%N)	3032.76	11.00	-	1.08	0.39	1.47	454.919	419.542	418.862
		Compost + 80% RD	3159.11	13.00		1.13	0.46	1.59	473.873	438.496	437.867
		Biofertilizer + 80% RD	3095.60	10.00	-	1.10	0.36	1.46	464.345	428.968	428.283
		Mixture Biofertilizer +Compost +80% RD	3276.60	14.00	-	1.17	0.50	1.67	491.497	456.12	455.521
Between inter.	Second 2nd	Recommended dose (100%N)	3210.68	-	-	1.08		1.08	481.602	446.602	445.676
		Compost + 80% RD	3405.11	-	-	1.14		1.14	510.767	475.767	474.890
		Biofertilizer + 80% RD	3227.75	-	-	1.08		1.08	484.163	449.163	448.237
		Mixture Biofertilizer +Compost +80% RD	3599.11	-	-	1.21		1.21	539.867	504.867	504.041
Stevia+ Faba bean	Third 3rd	Recommended dose (100%N)	4211.79	5.00	1.17	1.26	0.45	1.72	632.294	590.294	589.713
		Compost + 80% RD	4443.47	5.87	1.33	1.33	0.53	1.87	666.521	624.521	623.986
		Biofertilizer + 80% RD	4230.54	5.17	1.10	1.27	0.47	1.74	634.581	592.581	592.006
		Mixture Biofertilizer + Compost+80% RD	4579.36	6.77	1.43	1.38	0.62	1.99	686.904	644.904	644.401
Stevia+Wheat		Recommended dose (100%N)	4232.76	7.97	1.23	1.27	0.42	1.69	634.920	597.42	596.828
		Compost + 80% RD	4453.46	8.70	1.47	1.34	0.46	1.80	668.025	630.525	629.969
		Biofertilizer + 80% RD	4238.50	7.63	1.42	1.27	0.40	1.67	635.781	598.281	597.682
		Mixture Biofertilizer +Compost +80% RD	4590.45	9.60	1.91	1.38	0.51	1.88	688.575	651.075	650.543
Soil	Stevia	First harvest	2804						420.600	385.600	385.600
		Second harvest	2984						447.600	412.600	412.600
		Third harvest	3330						499.500	464.500	464.500
	Sunflower				1.250					10000	5500
	Maize				28					13440	5905
	Faba bean				11	2.3				27050	13050
	Wheat				19	3.5				18070	13070

L.E 480 for ardab of maize, L.E 8000 for ton of sunflower, L.E 750 for ardab wheat + LE1200 ton for straw, L.E 14.500 for ton faba bean + LE 1000 ton for straw, LE 150000 for ton stevia

Table 12: Effect of interactions between Intercropping pattern and sources of fertilization on LER, Total returns and MAI

Intercropping Crops	No of harvest	Fertilizer	Dry biomass yield (kg /fed)	Intercropping		LER = LERs + LER i			Total expense LE/fed	Net profit LE/fed	MAI
			Total stevia	Yield	Straw	LER S	LER i	LER			
Stevia+ Sunflower	First 1st	2020 / 2021									
		Recommended dose (100%N)	3354.67	516.67	-	1.16	0.41	1.56	507.334	470.047	469.406
		Compost + 80% RD	3413.25	700.00	-	1.18	0.55	1.73	517.588.	480.300	479.722
		Biofertilizer + 80% RD	3379.65	601.67	-	1.17	0.47	1.64	511.762	474.474	473.8642
		Mixture Biofertilizer +Compost+ 80% RD	3675.10	756.67	-	1.27	0.60	1.86	557.310	520.031	519.4934
Stevia+ Maize		Recommended dose (100%N)	3345.66	12.00	-	1.15	0.44	1.60	501.855	466.124	465.499
		Compost + 80% RD	3419.67	14.33		1.18	0.53	1.71	512.957	477.227	476.6422
		Biofertilizer + 80% RD	3388.73	11.33	-	1.17	0.42	1.59	508.315	472.584	471.9551
		Mixture Biofertilizer +Compost +80% RD	3686.35	15.00	-	1.27	0.56	1.83	552.960	517.226	516.6796
Between inter.	Second 2nd	Recommended dose (100%N)	3923.65	-	-	1.19		1.19	588.548	553.51	552.6697
		Compost + 80% RD	4041.27	-	-	1.23		1.23	606.191	571.156	570.343
		Biofertilizer + 80% RD	3975.13	-	-	1.21		1.21	596.270	561.235	560.4086
		Mixture Biofertilizer +Compost +80% RD	4027.66	-	-	1.23		1.23	604.149	569.114	568.301
Stevia+ Faba bean	Third 3rd	Recommended dose (100%N)	4423.76	4.73	1.08	1.29	0.39	1.68	663.576	621.534	620.9388
		Compost + 80% RD	4645.82	5.93	1.30	1.35	0.49	1.85	696.888	654.846	654.3055
		Biofertilizer + 80% RD	4478.03	4.73	1.22	1.30	0.39	1.70	671.716	629.674	629.0858
		Mixture Biofertilizer + Compost+80% RD	4827.49	6.93	1.65	1.41	0.58	1.98	724.141	682.099	681.5939
Stevia+ Wheat		Recommended dose (100%N)	4532.96	7.73	1.18	1.32	0.39	1.71	679.963	642.425	641.8402
		Compost + 80% RD	4650.52	8.27	1.37	1.35	0.41	1.77	697.600	660.062	659.497
		Biofertilizer + 80% RD	4557.03	7.87	1.35	1.33	0.39	1.72	683.572	646.035	645.4536
		Mixture Biofertilizer +Compost +80% RD	4859.45	9.03	2.00	1.41	0.45	1.87	728.941	691.403	690.8682
Soil	Stevia	First harvest	2900						435.000	400.000	400.000
		Second harvest	3286						492.900	489.400	489.400
		Third harvest	3435						515.250	480.250	480.250
	Sunflower			1.270					10160	5660	5660
	Maize			27					12960	5425	5425
	Faba bean			12	2.2				29200	15200	15200
	Wheat			20	3.7				19040	14040	14040

L.E 480 for ardab of maize, L.E 8000 for ton of sunflower, L.E 750 for ardab wheat + LE1200 ton for straw, L.E 14.500 for ton faba bean + LE 1000 ton for straw, LE 150000 for ton stevia