Tikrit Journal for Agricultural Sciences (2024) 24 (2): 178-196
DOI: https://doi.org/10.25130/tjas.24.2.13

IRAQI Academic Scientific Journals
العراقية المجلات الأكاديمية العلمية
TJAS
Tikrit Journal for Agricultural

ISSN:1813-1646 (Print); 2664-0597 (Online)
Tikrit Journal for Agricultural Sciences
Journal Homepage: http://www.tjas.org
E-mail: tjas@tu.edu.iq

Assessing the compost of *Prosopis farcta* and *Alhagi maurorum* as organic fertilizer for potato growth and yield (*Solanum tuberosum* L.)

Ghassan J. Zaidan [1], Kutaiba Y. Aied [2] and Abdulkareem E. S. Alkurtany [3]

[1,2] Department of Horticulture and Landscape, College of Agriculture, Tikrit university, Tikrit, Iraq.

[3] Department of Soil Science and Water Resource, College of Agricuture, Tikrit University, Tikrit, Iraq.

Correspondence email: ghassanjayed@tu.edu.iq

KEY WORDS:
Mineral fertilizer; manure; substance mushroom spent

Received: 30/01/2024
Revision: 22/04/2024
Proofreading: 28/04/2024
Accepted: 28/05/2024
Available online: 30/06/2024

© 2024.This is an open access article under the CC by licenses http://creativecommons.org/licenses/by/4.0

ABSTRACT

Growing potatoes requires great care because it needs large nutrients. Proper fertilization is a critical aspect of improving yield. This study comprises a field experiment to assess the impact of several fertilization approaches on the crop performance of potato (cv. Montreal). In this context, we used eight distinct fertilizer treatments: control (T0), standard mineral fertilizer (T1), substance mushroom spent (T2), cow + poultry manure (T3), compost (T4), 50% standard mineral fertilizer comprising substance mushroom spent (T5), 50% standard mineral fertilizer augmented with cow + poultry manure (T6) and 50% standard mineral fertilizer augmented with compost (T7). The results indicate that control treatment gave least days to mean germination time. While the standard mineral fertilizer (T1) had the highest values in chlorophyll content in leaves, single tuber weight, tuber count per plant, and plant yield. On the other hand, (T6) showed significant increment in number of tubers per plant. Meanwhile, (T7) treatment produced higher marketable yield and tuber per plant. Whereas, there are not significant difference among treatments in number of arial stems. on the other hand, these results were the lowest for the control treatment. Hence, the fertilization approach extensively impacts vegetative development and tuber yield.

تقييم كمبوست نباتي الشوك *Prosopis farcta* و العاقول *Alhagi maurorum* كسماد عضوي في نمو حاصل البطاطا (*Solanum tuberosum* L.)

غسان جايد زيدان[1] ، قتيبة يسر عايد[2] ، عبدالكريم عريبي سبع الكرطاني[3]

[1و2] قسم البستنة وهندسة الحدائق ، [3] قسم علوم التربة والمياه، كلية الزراعة ، جامعة تكريت ، العراق

الخلاصة

تتطلب زراعة البطاطا عناية كبيرة لأنها تحتاج إلى كميات كبيرة من العناصر الغذائية ، ويعد التسميد المناسب جانبًا مهمًا لتحسين العائد. ان الهدف من هذه التجربة هو تقييم تأثير أنواع من الاسمدة في نمو و حاصل البطاطا (صنف مونتريال). إذ استخدمت ثمانية معاملات سمادية : المقارنة (T0)، الأسمدة الكيميائية (المعدنية) (T1)، مخلفات انتاج الفطر (T2)، مخلفات البقر + مخلفات الدواجن (T3)، كومبوست الشوك و العاقول (T4)، الأسمدة الكيميائية بنسبة 50٪ مع مخلفات انتاج الفطر (T5)، الأسمدة الكيميائية بنسبة 50٪ مع مخلفات البقر و الدواجن (T6)، الأسمدة الكيميائية بنسبة 50٪ مع كومبوست الشوك و العاقول (T7). تشير النتائج إلى أن معاملة المقارنة (T0) قد أعطت اقل عدد أيام للبزوغ، بينما الأسمدة الكيميائية (T1) قد أعطت زيادة معنوية في كل من محتوى الأوراق من الكلورفيل و وزن الدرنة الواحدة و حاصل النبات الواحد. فيما أعطت معاملة (T6) اعلى عدد درنات لكل نبات، في حين أعطت معاملة T7 زيادة معنوية في كل من صفتي عدد الدرنات الصالحة للتسويق و الحاصل الصالح للتسويق. و لم يكن هناك اختلافات معنوية بين المعاملات في صفة عدد السيقان الهوائية. وبالتالي، فإن طريقة التسميد تؤثر بشكل كبير على النمو الخضري وإنتاجية الدرنات.

الكلمات الافتتاحية: سماد معدني ، سماد عضوي ، مخلفات انتاج الفطر

INTROUCTION

Potatoes (*Solanum tuberosum* L.) comprise a significant part of human food globally; hence, they are the fourth most consumed vegetable globally (FAOSTAT, 2020 and Al-Jaf *et al.*,2023). Potatoes' significant per capita use is understandable since they have ample carbohydrates and minerals; furthermore, potatoes have significant quantities of vitamin C, minerals, proteins, and antioxidants (Brown, 2005; Hussain and Ahmed, 2023).

Potato is among the important vegetables grown across the southern Mediterranean. Italy and Spain are significant producers, accounting for 1.3 and 2.0 million tons annually (FAOSTAT, 2020). Nevertheless, the past decade has witnessed an extensive increase in the farming sector with respect to the overall harvested area and potato produce (36.7% and 19.5%, respectively) that has been offset to an extent by higher yields owing to the use of more productive genotypes and better farming techniques (FAOSTAT, 2020). To improve overall yield, potato farmers have been

interested in defining suitable fertilization approaches, leading to additional benefits like lower cost and better quality (Fontes *et al.*, , 2010; Fontes *et al.*, , 2016).

The use of fertilizer plays a crucial role in agricultural production. The practice can be traced back to the Neolithic Revolution when humans transitioned from a nomadic lifestyle to farming. During this time, settlements were established, while migration was reduced. Initial settlement began, and waste was collected in pits near homes, as documented relating to Sumerian cities around 6000 BC (Diaz *et al.*,2007).

Research indicates that even earlier, manure was utilized to enhance crop growth (Bogaard *et al.*, , 2013). Today, organic fertilizers continue to be a vital component of agricultural production, alongside organic and mineral-based fertilization. Each type of fertilizer (organic manures, organic, and mineral) influences soil and crops through different mechanisms. Organic manures improve the physical, chemical, and biological properties of soil; however, their nutrient levels are low, requiring high application rates (Simon and Czakó, 2014; Bobulska *et al.*, , 2015; Hamm *et al.*, , 2016; Chen *et al.*, , 2018; Kobierski *et al.*, , 2020; Du *et al.*, , 2020). The constituents of organic fertilizers can vary greatly, both within and between varieties (such as slurries and manures), and is dependent on their source (Yang and Ha, 2013; Al-Ali amd El-Hamdani, 2023).

The rate at which manure is mineralized varies significantly based on manure type and environmental aspects. Organic manures with low carbon-to-nitrogen ratios, such as slurries, provide an extensive amount of nutrients in the first year of use, while those with a high C: N ratio, like farmyard manures (FYM), provide nutrients at a slower rate over an extended period (Eghball *et al.*, , 2002). Despite their benefits, even organic fertilizers can have a negative impact on the environment if used excessively or if they contain harmful substances that find their way into water or soil; such contaminants include veterinary pharmaceuticals (Ghirardini *et al.*, , 2020; Salman *et al.*, 2023).

For thousands of years, agriculture was carried out without relying on synthetic chemicals. Recent advancements in soil management have led to a rise in the use of chemical fertilizers to boost crop production by enhancing nutrient availability. However, using these agrochemicals leads to a decline in cultivable land quality and contributes to increased agricultural contamination. To address these issues, organic farming is the only viable alternative that relies solely on natural resources, such as organic matter, plant and animal waste, and microbes (Ahmad *et al.*, , 2007). The use of organic fertilizers has proven to be effective in enhancing soil fertility and reducing

pest and disease concerns (Abbasi *et al.*, , 2002; Barker and Bryson, 2006; Khadem *et al.*, , 2010). Numerous works recently validated organic manure use to enhance potato development and yield (Wazir *et al.*, , 2018; Ahmed *et al.*, , 2019; Abou El-Goud *et al.*, , 2021). Organic fertilization is emerging as a crucial aspect of environmentally conscious and sustainable farming. The residual aspect of organic sources creates better viability for the complete ecosystem as opposed to individual crops (Arora and Maini, 2011). In recent times, farmers have shifted their preference to organic farming instead of synthetic fertilizers due to cost and soil efficacy and fertility concerns (Oyedeji *et al.*, , 2014).

Thus, the aim of the current research is to assess the impact of different varieties of organic fertilizers on the growth and yield of potato plants and to explore substitute, economically sustainable, and environmentally conscious techniques of utilizing chemical fertilizers.

MATERIALS AND METHODS

Location of the Experiment and its Layout

The experiment was conducted at an experimental region at the Department of Horticulture and Landscape/ College of Agriculture/ Tikrit University in Tikrit, Iraq. The research area is situated at 34o 40/ 51.93// N latitude and 43o 38/ 59.87// E longitude. The test evaluated the Montreal variety potato (*Solanum tuberosum* L.). This hybrid high-yield variety was introduced in 1997 through Amalia X Amora cultivars. The Montreal potato possesses a smooth yellowish skin, medium tuber size, and oval shape. This potato species has an extensive dry content percentage and is resilient against viral diseases (Canadian Food Inspection, 2020). An overall area of 90 m^2 was used for cultivating Montreal variety tubers having about 50 g weight along with other materials. Before planting, soil preparation was done to build about 20 cm height ridges. The tubers were hand planted on 17th February 2019. The ridges were separated by 75 cm, while a 30 cm separation was maintained within a ridge; the plantation was made at 8–10 cm depth.

Sand clay loam soil was used. A soil sample was gathered from 0-15 cm depth. This sample helped determine the chemical and physical characteristics before soil was chemically fertilized. The chemical properties of the gathered sample were ascertained using this technique (Hunter, 1984). The soil was mildly alkaline (pH 7.4) with inadequate fertility; the organic material was 1.12 g kg^{-1}. Element availability was at 48 mg kg^{-1} N, 6.8 mg kg^{-1} phosphorous, and 93 mg kg^{-1} potassium. Moreover, other properties include 1.3 g cm^{-3} bulk density, 2.22 ds m^{-1} EC, 16 cmol kg^{-1} soil CEC,

160 mg kg^{-1} CaCo3 and 130 mg kg^{-1} $CaSo_4$. The tests were conducted in adherence with the Randomize Complete Block Design. Every test plot comprises one ridge.

Treatments

The plot was 1 m wide and 3 m long (3 m^2); there were 1 m wide corridors between the plots. Every fertilization test comprised four identical samples; hence, 32 plots were tested for the study. Where there were 10 plants in experiment unit. The study comprised eight fertilizer treatments: (i) Control (T0) without fertilizer use, (ii) standard mineral fertilizer (T1) in quantities that allowed using 200 kg ha^{-1} of N based on urea (46% N), 160 kg ha^{-1} P based on triple super phosphate (20% P), and 200 kg ha^{-1} K based on potassium sulphate (48% k). (iii) Substances mushroom spent (SMS) at 20 t ha^{-1} level (T2), (iv) cow waste with poultry manure at 20 t ha^{-1} level (T3), (v) compost at 20 t ha^{-1} level (T4), (vi)1/2 portion typical mineral fertilizer + substances mushroom spent (T5), (vii) 1/2 typical mineral fertilizer + cow waste and poultry manure (T6) and (viii) 1/2 typical mineral fertilizer + compost (T7).

Urea was the fertilizer source to provide nitrogen for treatments T1, T5, T6 and T7. Two doses were used (50% at planting day; subsequently, 45 days). Other manures and mineral fertilizers were used during planting. The drip irrigation approach was used; hoeing was used for ridge and weed removal. Pests and other harmful organisms were kept in check using chemical means based on conventional cultivation standards.

Application of Compost, NPK, and Organic Fertilizer

A single dose of organic fertilizer and compost was used after land preparation. Table 1 lists an assessment of organic and compost-based fertilizers. Concerning the use of mineral fertilization, potassium and phosphorous treatments were conducted manually when the soil was prepared. Superphosphate (20%) and potassium sulphate (48%) supplementation were used, while nitrogen was based on two identical portions used when the soil was prepared. Urea (46%) was used after six weeks to provide additional nitrogen.

Table 1. Nutritive content of different organic fertilizers used in the experiment

Character	Unit	Compost of Prosopis	Compost of Alhagi	SMS	Poultry manure	Cow manure
pH		7.2	7.2	7.2	7.3	7.1
EC	ds m^{-1}	2.49	2.49	5.37	6.34	5.93
Total N	%	2.94	2.83	2.21	2.71	2.04
P	ppm	156.46	148.09	13.42	19.16	9.67
K	ppm	141	139	146	132	122
Moisture content	%	7.62	6.92	13.94	6.84	17.68
Organic C	%	49	51	59	55	57
C/N	%	16	18	27	20	28

Data Recorded

The crops were harvested 120 days after planting. Random selection was used to identify five plants from every plot.

Characteristics

a) Man germination time (day): After the seeds were planted, the Mean Germination Time (MGT) was estimated (Gairola *et al.*, , 2011) by studying the daily seed germination and was calculated as:

MGT = (n1 x d1) + (n2 x d2) + ----------/ Total number of germination seeds

Where, *n* refers to the number of the germinated seeds; *d* indicates the number of days.

b) Numbers of aerial stem (stem plant^{-1}): The number of aerial stems was measured and then the average was taken for five plants from each experimental unit.

c) Chlorophyll content in the leaves (SPAD): It was calculated using a Chlorophyll meter (SPAD-502). The chlorophyll content was calculated from the fourth and fifth leaves of the apical of plant.

d) Single tuber weight (g tuber^{-1}): The single of tuber was calculated by dividing the total yield of tubers by the number of tubers.

e) Numbers of tuber (tuber plant^{-1}): The number of tubers per plant was calculated by dividing the total number of tubers by the number of plants.

f) Yield of plant (kg plant^{-1}): The total yield was counted per plant by dividing the weight of the total yield of plants by the number of plants.

g) Numbers of tuber marketable (tuber plant^{-1}): The number of tubers per plant was calculated by dividing the total number of tubers by the number of plants after excluding tubers weighing less than 10 g and damaged ones.

h)Yield of marketable tuber per plant (kg plant^{-1}): The yield of marketable tuber per plant calculated by dividing the weight of the total yield of plants by the number of plants after excluding tubers weighing less than 10 g and damaged ones.

Statistical Analysis

The gathered data were assessed using statistical techniques: analysis of variance (ANOVA) technique and mean differences concerning treatments were contrasted using the Least Significant Design Test (LSD) using the SAS statistical processor software.

RESULTS AND DISSCUSION

The impact of various organic fertilizer sources affected mean germination time significantly (Fig. 1). The control treatment (T0) had the lowest day count pertaining to mean germination time. The control was followed by 1/2 mineral fertilizer + cow manure (T6), mineral fertilizer (T1) and 1/2 mineral fertilizer + compost (T7), respectively, at an identical statistical rank. On the other hand, compost-only treatment (T4) was associated with the highest day count concerning mean germination time. Hence, mean germination time differed significantly primarily due to the use of reserved fertilizing nutrients in the mother tuber (Love and Thompson-Johns, 1999; Kabir *et al.*, , 2004; Zaili and Alabdaly, 2023).

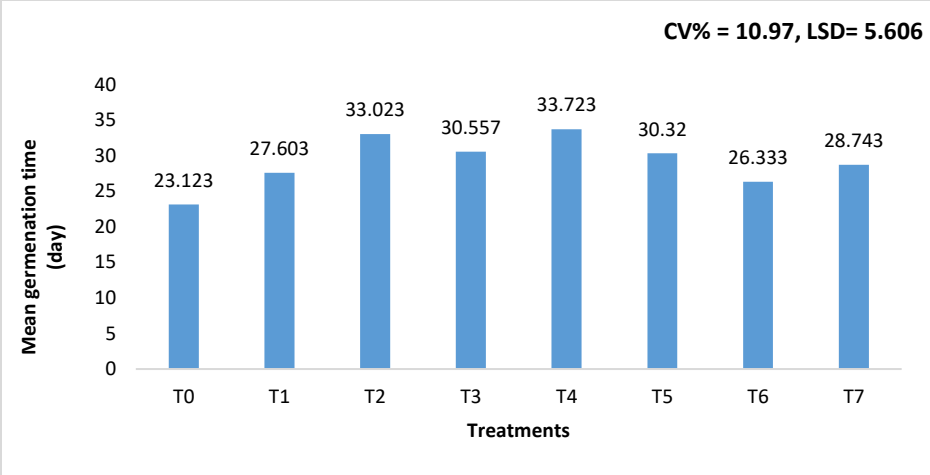

Fig. 1. Mean germination time (day)as affected by organic compost and mineral fertilizers individually or in different combination rates from both

T0: Unfertilized cheek (control); T1: Standard mineral fertilizer; T2: Substances mushroom spent (SMS); T3: Cow + poultry manure; T4: Compost; T5: 1/2 standard mineral fertilizer + substances mushroom spent; T6: 1/2 standard mineral fertilizer + cow with poultry manure; T7: 1/2 standard mineral fertilizer + compost. (CV: Coefficient of variation, LSD: Least Significant Difference).

Aerial stems of potato were not significantly affected by different fertilizers (Fig. 2).

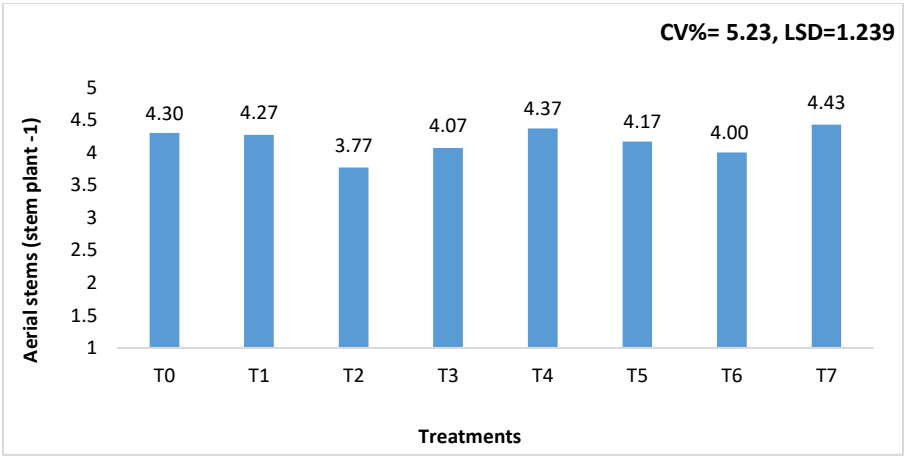

Fig. 2. Aerial stem (stem plant^{-1})as affected by organic compost and mineral fertilizers individually or in different combination rates from both

T0: Unfertilized cheek (control); T1: Standard mineral fertilizer; T2: Substances mushroom spent (SMS); T3: Cow + poultry manure; T4: Compost; T5: 1/2 standard mineral fertilizer + substances mushroom spent; T6: 1/2 standard mineral fertilizer + cow with poultry manure; T7: 1/2 standard mineral fertilizer + compost. (CV: Coefficient of variation, LSD: Least Significant Difference).

Leaf chlorophyll levels are presented in Fig. 3. The outcomes suggest statistically significant differences concerning different treatments. The peak chlorophyll content was associated with the standard mineral fertilizer treatment (T1), while the cow and poultry manure (T3) treatment provided the least chlorophyll. Chlorophyll levels in plants are dependent on the levels of nitrogen available in soil; furthermore, plant nitrogen uptake is also critical for arable farming. Nitrogen uptake by plants is critical because it is needed for chlorophyll synthesis, which, in turn, is necessary for photosynthesis, which refers to the use of absorbed radiance to produce biomass (Jongschaap and Booij, 2004).

Leaf chlorophyll levels in potatoes have been studied for several plants as indirect nitrogen level indicators (Gianquinto *et al.*, , 2003). Hence, chlorophyll levels are typically normalized to a suitable N-fertilized reference (Denuit *et al.*, , 2002). Higher chlorophyll levels in leaves after mineral fertilizer use are attributed to chlorophyll production since it is critically dependent on N availability. Nitrogen is the primary element for amino acids; therefore, proteins and lipids, such as galactolipids are fundamental components of chloroplasts (Marschner, 1995).

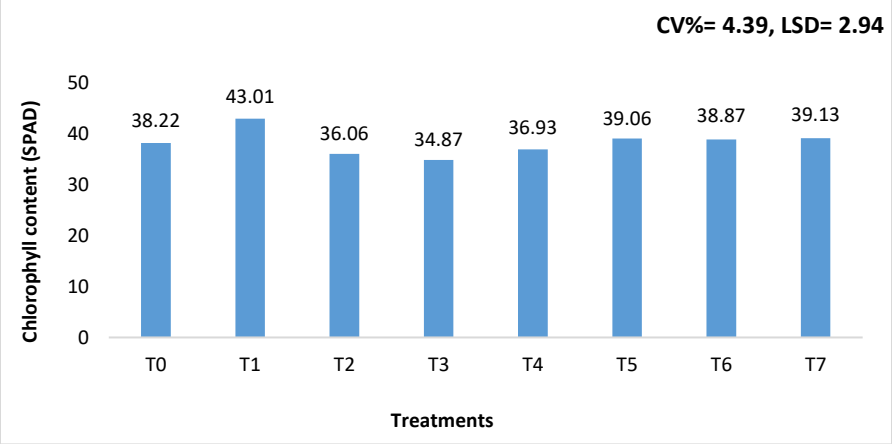

Fig. 3. Chlorophyll content (SPAD) in potato leaves as affected by organic compost and mineral fertilizers individually or in different combination rates from both

T0: Unfertilized cheek (control); T1: Standard mineral fertilizer; T2: Substances mushroom spent (SMS); T3: Cow + poultry manure; T4: Compost; T5: 1/2 standard mineral fertilizer + substances mushroom spent; T6: 1/2 standard mineral fertilizer + cow with poultry manure; T7: 1/2 standard mineral fertilizer + compost. (CV: Coefficient of variation, LSD: Least Significant Difference).

Single tuber weight

As indicated in Fig. 4, the use of chemical fertilizer (T1) provided a significant rise in individual tuber weight (87.86 g), while the control (T0) weighed 46.32 g. Also, the differences between treatments T2, T3 and T4 and the control are insignificant. Plants fertilized using inorganic treatments had adequate nitrogen, phosphorus, and potassium levels, allowing noteworthy development, better foliage, increased photosynthesis, and larger tubers (Imas and Bansal, 1999). Phosphorous and nitrogen enhance tuber development (De La Morena *et al.*, , 1994). It was ascertained that inorganic fertilizers provide nitrogen, phosphorus, and potassium, enhancing tuber size. Fertilizers enhance dry content and protein levels in potato tubers (Zelalem *et al.*, , 2009).

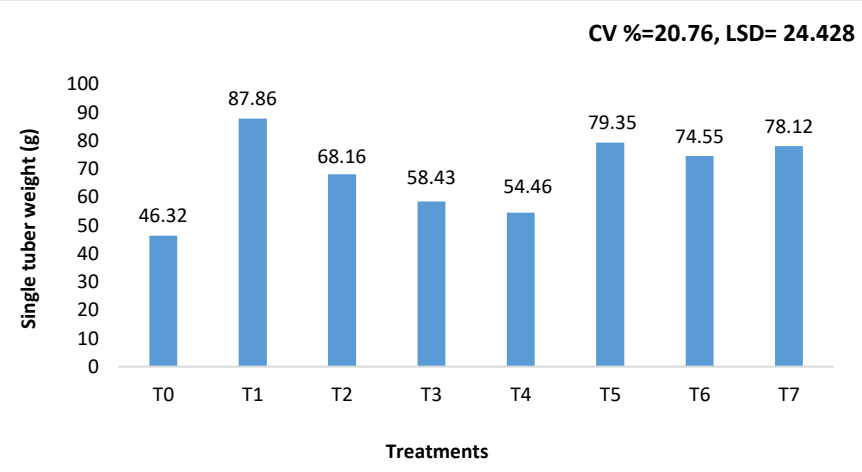

Fig. 4. Single tuber weight (g) as affected by organic compost and mineral fertilizers individually or in different combination rates from both

T0: Unfertilized cheek (control); T1: Standard mineral fertilizer; T2: Substances mushroom spent (SMS); T3: Cow + poultry manure; T4: Compost; T5: 1/2 standard mineral fertilizer + substances mushroom spent; T6: 1/2 standard mineral fertilizer + cow with poultry manure; T7: 1/2 standard mineral fertilizer + compost. (CV: Coefficient of variation, LSD: Least Significant Difference).

The impact of organic and inorganic treatments on tuber count is indicated in Fig. 5. Plots fertilized using 50% mineral fertilizer with cow manure (T6) or 100% mineral fertilizer (T1) indicated a noteworthy increase in tuber count than the control treatment (T0). On the other hand, tuber count associated with T2, T3, T4, and T7 had insignificant differences compared to the control treatment. Kumar and Wareing (1972) determined that nitrogen availability enhanced

Gibberellins production, controlling stolon count, and leading to a higher tuber count. The observations are aligned with Zidan and Dauob (2005), Hamedan *et al.,* (2006), Al-Balikh (2008) and Amara and Mourad (2013).

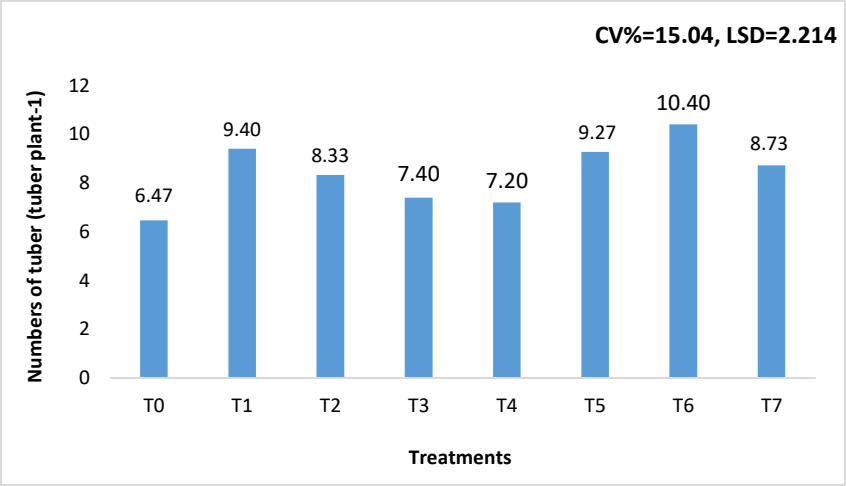

Fig. 5. Number of tuber (tuber plant^{-1}) as affected by organic compost and mineral fertilizers individually or in different combination rates from both

T0: Unfertilized cheek (control); T1: Standard mineral fertilizer; T2: Substances mushroom spent (SMS); T3: Cow + poultry manure; T4: Compost; T5: 1/2 standard mineral fertilizer + substances mushroom spent; T6: 1/2 standard mineral fertilizer + cow with poultry manure; T7: 1/2 standard mineral fertilizer + compost. (CV: Coefficient of variation, LSD: Least Significant Difference).

The control treatment was devoid of fertilizer, leading to significantly low yield characteristics than those fertilized using minerals (T1), 50% mineral fertilizer comprising mushroom spent (T5) and 50% mineral fertilizer with cow manure (T6) (Fig. 6). In contrast, compost and cow and poultry manure treatment had insignificant differences than the control sample. Plant yield was significantly affected by fertilizers. Plant yield concerning tuber count, weight, and plant yield increased due to adequate levels of nitrogen, phosphorus and potassium derived from these inorganic sources. Therefore, plant yield was superior for inorganic fertilizers. Researchers (Kleinkopf *et al.*,1981; Kader, 2023) indicated a significant correlation between fertilization and yield.

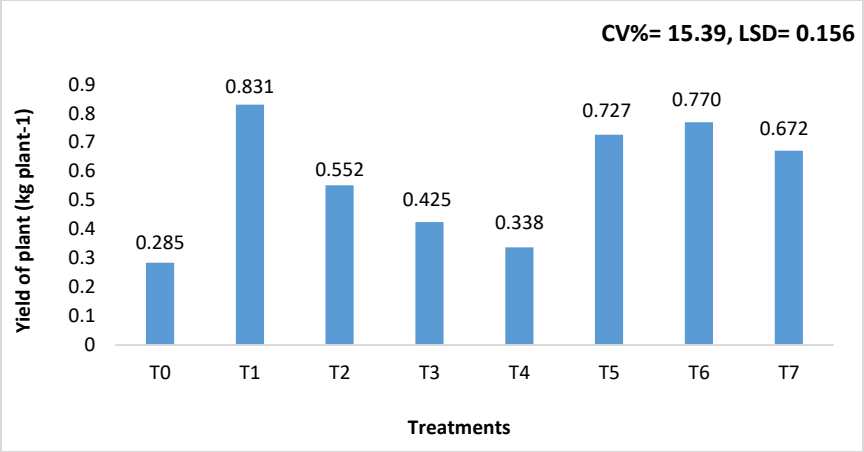

Fig. 6. Yield of plant (kg plant^{-1}) as affected by organic compost and mineral fertilizers individually or in different combination rates from both

T0: Unfertilized cheek (control); T1: Standard mineral fertilizer; T2: Substances mushroom spent (SMS); T3: Cow + poultry manure; T4: Compost; T5: 1/2 standard mineral fertilizer + substances mushroom spent; T6: 1/2 standard mineral fertilizer + cow with poultry manure; T7: 1/2 standard mineral fertilizer + compost. (CV: Coefficient of variation, LSD: Least Significant Difference).

The outcomes concerning the primary effects of various fertilizers on marketable tuber count are indicated in Fig. 7. The outcomes typically suggest that the mean values of marketable tubers across treatments differed significantly. Marketable tuber count was maximum for 50% mineral fertilizer with compost (T7) treatment, while the lowest value was associated with the control (T0).

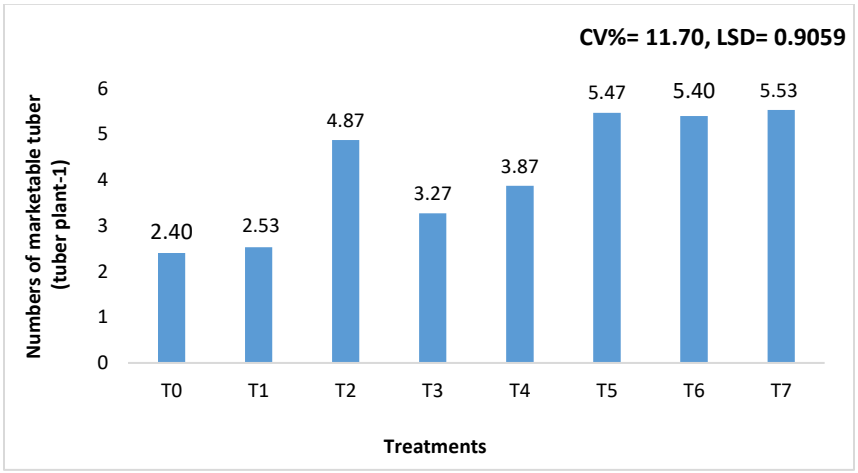

Fig. 7. Number of tuber marketable (tuber plant^{-1}) as affected by organic compost and mineral fertilizers individually or in different combination rates from both

T0: Unfertilized cheek (control); T1: Standard mineral fertilizer; T2: Substances mushroom spent (SMS); T3: Cow + poultry manure; T4: Compost; T5: 1/2 standard mineral fertilizer + substances mushroom spent; T6: 1/2 standard mineral fertilizer + cow with poultry manure; T7: 1/2 standard mineral fertilizer + compost. (CV: Coefficient of variation, LSD: Least Significant Difference).

The outcomes indicate that concurrent use of organic and inorganic fertilizers is extremely significant (than other treatments). It is attributed to superior nutrient levels and the ability to raise soil nutrient concentration through increased biological activity (Pengthamkeerati *et al.*, , 2011).

The outcomes of the primary impact of mineral and organic fertilizers on marketable tuber yield per plant are depicted in Fig. 8. The computed outcomes indicate that the mean marketable tuber yield per plant was the highest for T7 (50% mineral fertilizer with compost). Further, the outcomes indicated that the control sample inhibited marketable yield to 0.189 kg plant^{-1}.

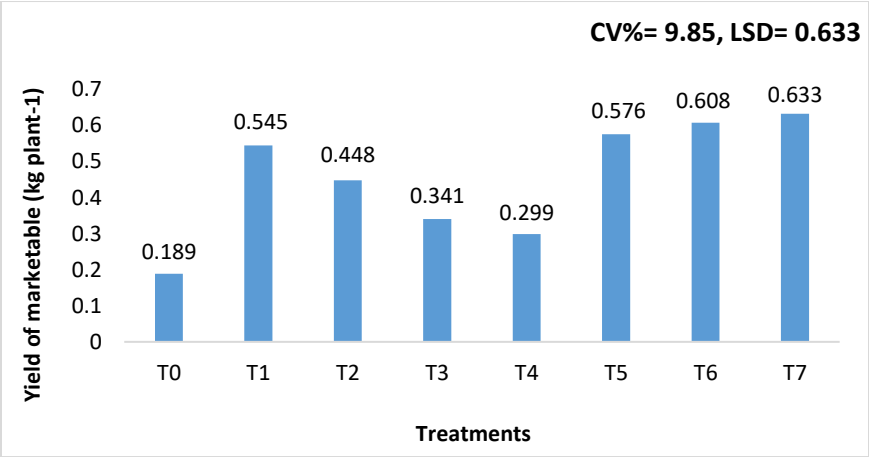

Fig. 8. Yield of marketable tuber (kg plant^{-1}) as affected by organic compost and mineral fertilizers individually or in different combination rates from both

T0: Unfertilized cheek (control); T1: Standard mineral fertilizer; T2: Substances mushroom spent (SMS); T3: Cow + poultry manure; T4: Compost; T5: 1/2 standard mineral fertilizer + substances mushroom spent; T6: 1/2 standard mineral fertilizer + cow with poultry manure; T7: 1/2 standard mineral fertilizer + compost. (CV: Coefficient of variation, LSD: Least Significant Difference).

The results indicate superior marketable tuber count (including plant-specific levels) per hectare. Aligned outcomes were presented by Arzani (2001) and Belhjati *et al.*, (2013). Moreover, it is expected because similar fertilizer use led to the maximum number of marketable tubers, leading to the highest marketable tuber yield. The outcomes are aligned with Shafeek *et al.*, (2001), Arancon *et al.*, (2003), Tu *et al.*, (2006) and Amir *et al.*, (2013).

CONCLUSION

The outcomes of this work indicate that the type of fertilizer used for plants significantly impacts potato yield and vegetative development, including the end-use of the produce.

Concerning yield, the significance of offering the required inorganic substances is critical for improving yield, while timing fertilizer use is also vital. This research indicates that mineral fertilization provided the maximum yield. Mineral fertilizer use also regulates leaf chlorophyll, which is associated with the maturity of the end product. Marketable tuber count and yield per tuber were regulated due to the fertilization sample. Further, the potato plant provided varying outcomes. Overall, the study outcomes suggest that different fertilizer approaches are critical for effectiveness, as indicated by tuber yield.

CONFLICT OF INTEREST

The authors declare no conflicts of interest associated with this manuscript.

REFRANCES

Abbasi, P. A., Al-dahmani, J., Sahin, F., Hoitinkand, H. A. J. & Miller, S. A. (2002). Effect of compost amendments on disease severity and yield of tomato in con-ventional and organic production systems. *Plant Disease*, *86*(2), 156-161.

Abo El-Gouad, A. K., Al-Masoodi, F. R., Elzopy, K. A., & Yousry, M. M. (2021). Performance of potato cultivars in an organic farming system using organic fertilizers, vermicompost and azolla. *Australian Journal of Crop Science*, *15*(07), 1081-1088.

Ahmad, R., Jilani, G., Arshad, M., Zahir, Z. A. & Khalid, A. (2007). Bio-conversion of organic wastes for their recycling in agriculture: an overview of perspectives and prospects. *Annals of Microbiology*, *57*(4), 471-479.

Ahmed, F., Mondal, M. M. A. & Akter, M. B. (2019). Organic fertilizers effect on potato (*Solanum tuberosum* l.) tuber production in sandy loam soil. *International Journal of Plant & Soil Science*, *29*(3), 1-11.

Al-Ali, H., & I. H. El-Hamdani, H. (2023). Response of zizphus mauritiana l transplants to foliar spraying with chelated fe and alga mix in vegetative and chemical growth characteristics traits for al-tafahi cultivar. *Anbar Journal of Agricultural Sciences*, *21*(2), 563-574. doi: 10.32649/ajas.2023.179755

Al-Balikh, K. (2008). The influence of kind and quantity of manure on productivity and quality characteristics for spring potato in Raqqa province. Raqqa research center, Alfurat University, Faculty of Agriculture.

Al-Jaf , H. M., Mubarak , I., K., A., Abed , M., B., & Al-Dulaimy , F. Z., A. (2023). Artificial seeds technology: a review. *Anbar Journal of Agricultural Sciences*, *21*(2), 396-407. doi: 10.32649/ajas.2023.181869

Amara, D. G. & Mourad, S. M. (2013). Influence of organic manure on the vegetative growth and tuber production of potato (*Solanum tuberosum* L. var. Spunta) in a Sahara Desert Region. *International Journal of Agriculture and Crop Sciences*, *5*(22), 2724-2731.

Amir, A. N., Mohammad, R. H. S. H., Mohammad, T. D. & Faezeh, F. (2013). Influence of nitrogen fertilizer and cattle manure on the vegetative growth and tuber production of potato. *Intern. J. of Agric. and Crop Sci.*, *5*(2), 147-154.

Arancon, N. Q., Edwards, C. A., Bierman, P.J., Metzger, D., Lee, S. & Welch, C. (2003). Effects of vermin composts on growth and marketable fruits of field-grown tomatoes, peppers and strawberries. *Pedobiologia*, *47*(5-6), 731- 735.

Arora, N. & Maini, P. (2011). Anaerobic digested slurry an input for sustainable agriculture. *Asian Journal of Experimental Sciences*, *25*(1), 59-62.

Arzani, A. (2001). *Breeding crop plants*. (2nd ed.) Esfahan University of Technology Press. p. 257.

Barker, A.V. & Bryson, G. M. (2006). Comparisons of composts with low or high nutrient status for growth of plants in containers. *communications in soil science and plant analysis*, *37*(9-10), 1303-1319.

Belhjati, S., Choukan, R., Hassanabadi, H. & Delkhosh, B. (2013). The evaluation of yield and affective characteristics on yield of promising potato clones. *Annals of Biological Research, 4*,(7), 81-84.

Bobulska, L., Fazekašová, D., Angeloviˇcová, L. & Kotorová, D. (2015). Impact of ecological and conventional farming systems on chemical and biological soil quality indices in a cold mountain climate in slovakia. *Biol. Agric. Hortic., 31*(3), 205–218.

Bogaard, A., Fraser, R., Heaton, T. H. E., Wallace, M., Vaiglova, P., Charles, M., Jones, G., Evershed, R. P., Styring, A. K., Andersen, N.H., Arbogast, R., Bartosiewicz, L., Gardeisen, A., Kanstru, M., Maier, U., Marinova, E., Ninov, L., Schäfer, M & Stephan, E. (2013). Crop manuring and intensive land management by europe's first farmers. *Proc. Natl. Acad. Sci. Usa, 110*(31), 12589–12594.

Brown, C. R. (2005). Antioxidants in potato. *Am. J. Potato Res.* 82, 163–172.

Canadian Food Inspection (2020). Government of Canada. Crop Report (3/3/2020). https://inspection.gc.ca/english/plaveg/pbrov/cropreport/pot/app00009525e.shtml.

Chen, Y., Camps-Arbestain, M., Shen, Q., Singh, B. & Cayuela, M. L. (2018). The long-term role of organic amendments in building soil nutrient fertility: a meta-analysis and review. *Nutrient Cycling in Agroecosystems, 111*, 103–125.

De La Morena, I., Guillen, A. & Garcia Del Morel, L. (1994). Yield development in potatoes as influenced by cultivar and timing and level of nitrogen fertilizer. *American Potato Journal*, 71: 165-173.

Denuit, J. P., Olivier, M., Goffaux, M. J., Herman, J., Goffart, J., Destain, J. & Frankinet, M. (2002). Management of nitrogen fertilization of winter wheat and potato crops using the chlorophyll meter for crop nitrogen status assessment. *Agronomie*, *22*(7-8), 847-855.

Diaz, L.F., De Bertoldi, M., Bidlingmaier, W. & Stentiford, E. (2007). *Compost science and technology-waste management series*. Elsevier (1st ed.): Amsterdam, The Netherlands, Volume 8.

Du, Y., Cui, B.; Zhang, Q., Wang, Z., Sun, J. & Niu, W. (2020). Effects of manure fertilizer on crop yield and soil properties in China: a meta-analysis. *Catena*, *193*(5), 104617.

Eghball, B., Wienhold, B. J., Gilley, J. E. & Eigenberg, R. A. (2002). Biological systems engineering: papers and publications mineralization of manure nutrients mineralization of manure nutrients. *Journal of Soil and Water Conservation, 57*(6), 470–473.

FAOSTAT. (2020). Production and trade statistics. available online: http://www.fao.org/faostat/en/#data/qc/ visualize (accessed on 28 february 2020).

Fontes, P. C. R., Braun, H., Busato, C. & Cecon, P. R. (2010). Economic optimum nitrogen fertilization rates and nitrogen fertilization rate effects on tuber characteristics of potato cultivars. *Potato Research, 53*(3), 167–179.

Fontes, P. C. R., Braun, H., De Castro Silva, M. C., Coelho, F.S., Cecon, P. R. & Partelli, F.L. (2016). Tuber yield prognosis model and agronomic nitrogen use efficiency of potato cultivars. *Australian Journal of Crop Science, 10*(7), 933–939.

Gairola, K., Nautiyal, A., & Dwivedi, A. (2011). Effect of temperatures and germination media on seed germination of *Jatropha curcas* Linn. *Advances in Bioresearch, 2*(2), 66-71.

Ghirardini, A., Grillini, V. & Verlicchi, P. (2020). A review of the occurrence of selected micropollutants and microorganisms in different raw and treated manure–environmental risk due to antibiotics after application to soil. *Science of The Total Environment, 707*, 136118.

Gianquinto, G., Sambo, P. & Pimpini, F. (2003). The use of spad-502 chlorophyll meter for dynamically optimizing the nitrogen supply in potato crop: first results. *Acta Horticulturae, 627*(29), 225-230.

Hamedan, M., Zidan, R. & Othman, J. (2006). The effect of organic manure levels on the growth and productivity of potato (*Solanum tuberosum* l.), cv. Marfona. *Tishreen University Journal for Studies and Scientific Research – Biological Science Series*, *28*(1).

Hamm, A. C., Tenuta, M,.; Krause, D. O., Ominski, K. H., Tkachuk, V. L. & Flaten, D.N. (2016). Bacterial communities of an agricultural soil amended with solid pig and dairy manures, and urea fertilizer. *Applied Soil Ecology, 103*, 61–71.

Hunter, A. H. (1984). *Soil fertility analytical service in Bangladesh: a consultancy report of 1984*, Bangladesh Agricultural Research Council, Dhaka, Bangladesh, 49.

Hussain, J. A., & Ahmed, Sh. M. (2023). Response of some growth traits of gardenia jasminoides ellis to shading and fertilization with iron and sulfur. *Anbar Journal of Agricultural Sciences*, *21*(2), 505-514. doi: 10.32649/ajas.2023.179750

Imas, P. & Bansal, S. (1999). *Potassium and integrated nutrient management in potato*. Proceedings of the Global Conference on Potato, New Delhi, 6-11 December 1999, 6-11.

Jongschaap, R. E. E. & Booij, R. (2004). Spectral measurements at different spatial scales in potato: relating leaf, plant and canopy nitrogen status. *International Journal of Applied Earth Observation and Geoinformation, 5*(3), 205- 218.

Kabir, M., Alam, M., Hossain, M., Hossain, M. & Hossain, M. (2004). Yield performance of whole tuber and cut-piece planting of potato. *Tropical Science, 44*(1), 16-19.

Kader, Sh. J. (2023). Study the effect of foliar application of gibberellic acid (ga3) and liquid calcium on growth and fruit quality of pomegranate trees (punica granatum l.) Cv. Sawa. *Anbar Journal of Agricultural Sciences*, *21*(1), 71-86. doi: 10.32649/ajas.2023.179717

Khadem, S. A., Galavi, M., Ramrodi, M., Mousavi, S. R., Rousta, M. J. & Mogha-Dam, R. P. (2010). Effect of animal manure and superabsorbent polymer on corn leaf relative water content, cell membrane stability and leaf chlorophyll content under dry condition. *Australian Journal of Crop Science, V. 4*(8), 642-647.

Kleinkopf, G. E., Westermann, D. T. & Dwelle, R. B. (1981). Dry matter production and nitrogen utilization by six potato cultivars. *Agronomy Journal, 73*: 799-802.

Kobierski, M., Lemanowicz, J., Wojewódzki, P. & Kondratowicz-Maciejewska, K. (2020). The effect of organic and conventional farming systems with different tillage on soil properties and enzymatic activity. *Agronomy*, *10*, 1809.

Kumar, D. & Wareing, P. F. (1972). Factors controlling stolon development in the potato plant. *New Phytologist, 71*(4), 639-648.

Love, S. & Thompson-Johns, A. (1999). Seed piece spacing influences yield, tuber size distribution, stem and tuber density and net returns of three processing potato cultivars. *Horticulture Science Journal, 34*(4),629-633.

Marschner, H. (1995). *Mineral Nutrition Of Higher Plants*. (2nd ed.). Academic Press Nd.

Oyedeji, S., Animasaun, D. A., Bello, A. A. & Agboola, A. (2014) Effect of npk and poultry manure on growth, yield, and proximate composition of three ama-ranths. *Journal of Botany, 2014, Article ID: 828750, 6 p.*

Pengthamkeerati, P., Motavallib, P.P. & Kremerc, R. J. (2011). Soil microbial activity and functional diversity changed by compaction, poultry litter and cropping in a claypan soil. *Applied Soil Ecology, 48*(1), 71-80.

Salman, D. A., Hussein, A. W., & Mhawesh, O. A. (2023). Improving mini tuber potato growth and yield by some plants aqueous extract and earth worm compost. *Anbar Journal of Agricultural Sciences*, *21*(2), 656-666. doi: 10.32649/ajas.2023.144707.1098

Shafeek, M. R., El-Desuki, M. & Shaheen, A. M. (2001). Growth and yield of some potato cultivars affected by sources of fertilization. *Egyptian Journal of Applied Science, 16*(4), 242-260.

Simon, T. & Czakó, A. (2014). Influence of long-term application of organic and inorganic fertilizers on soil properties. *Plant Soil Environ., 60*(7), 314–319.

Tu, C., Ristaino, J. B. & S. Hu, S. (2006). Soil microbial biomass and activity in organic tomato farming systems: effects of organic inputs and straw mulching. *Soil Biol. Biochem., 38*(2), 247-255.

Wazir, A., Gul, Z. & Hussain, M. (2018). Comparative study of various organic fertilizers effect on growth and yield of two economically important crops, potato and pea. *Agricultural Sciences, 9*(6),703-717

Yang, Z. & Ha, L. (2013). Analysis and comparison of nutrient contents in different animal manures from Beijing suburbs. *Agricultural Sciences, 4*(2), 50–55.

Zaili, A. S., & Alabdaly, M. M. (2023). Response of growth and yield of local garlic *allium sativum* to potassium fertilization and planting date. *Anbar Journal of Agricultural Sciences*, *21*(1), 54-63. doi: 10.32649/ajas.2023.179715.

Zelalem, A., Tekalign, T. & Nigussie, D. (2009). Response of potato (*Solanum tuberosum* l.) to different rates of nitrogen and phosphorus fertilization on vertisols at Debre Berhan, in the central highlands of Ethiopia. *african journal of plant science,3*(2), 16-24.

Zidan, R. & Dauob, S. (2005). Effect of some humic substances and amino compounds on growth and yield of potato, *Solanum tuberosum* L. *Tishreen University Journal for Studies and Scientific Research - Biological Sciences Series, 27*(2), 92-100.