Kirkuk University Journal for Agricultural Sciences
ISSN:2958-6585
https://kujas.uokirkuk.edu.iq

RESEARCH ARTICLE https://doi.org. 10.58928/ku26.17322

Effect of Organic (compost) and Inorganic (NPK) Fertilizers on Safflower (*Carthamus Tinctorius* L.) Growth, Yield and Seed Oil Content

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Received:12/10/2025 **Revised: 17/04/2025** **Accepted: 13/09/2026** **Published: 15/09/2026**

ABSTRACT

A field experiment was carried out during 2023-2024 at the Qilyasan Agricultural Research Station, College of Agricultural Engineering Sciences. University of Sulaimani. To determine the effect of two types of organic (compost) and inorganic 20:20:20 NPK fertilizers levels on safflower (*Carthamus tinctorius* L.) growth, seed yield and oil percentage. The treatments consisted of three levels of organic fertilizer (0, 6, and 12 ton. ha^{-1} plant compost), three levels of inorganic fertilizers (0, 60, and 120 kg. ha^{-1} NPK) and two varieties of safflower (Gilla and Russi). The results showed that among the growth traits the greatest LAI was produced by Russi variety under 120kg ha^{-1} NPK whilst the tallest plant was produced by Gilla variety under 60 and 120 kg. ha^{-1} NPK compared to other treatments.. However, both varieties produced the highest No.of branches under 12ton.ha^{-1} compost and the highest leaves dry weight under 120 kg. ha^{-1}NPK and 12 ton ha^{-1} compost respectively, compared to other treatments. The highest seed yield kg. ha^{-1} and its yield components (No.of capitulum $plant^{-1}$, weight of capitulum $plant^{-1}$, No.of seed $capitulum^{-1}$, weight of seed $capitulum^{-1}$, 1000 seed weight) were obtained by Russi variety under 60 and 120 kg. ha^{-1}NPK and 12 ton. ha^{-1} compost also oil% produced by Russi under 120 kg ha^{-1}NPK and 12 ton ha^{-1} compost compared to other treatments. This investigation suggests 12 ton. ha^{-1} compost for Russi variety under rain fed par with the 120 kg. ha^{-1}NPK fertilizer to produce the economic seed yield and seed oil content.

***Keywords*:** Safflower growth, compost, NPK, yield, and seed oil%.

INTRODUCTION

Safflower (*Carthamus tinctorius* L.) is an annual oil seed crop which is belongs to Composite family. It is commercially cultivated for it is high quality vegetative oil of that is extracted from the seed. It is mainly cultivated for the edible oil obtained from it is seed because contains a higher percentage of unsaturated fatty acids which is contains about 71-75 % linoleic acid and 16-20% oleic acid also contains the low levels of saturated fatty acids about 6- 8 % palmitic acid and 2-3% stearic acid **[1]**.linoleic acid has been shown to offer nutritional and therapeutic benefits such as prevention of coronary heart disease, arteriosclerosis, high blood pressure and hyper lipaemia **[2]**. The seeds of safflower are also a rich source of minerals (Zn, Cu, Mn and Fe), vitamins (thiamine 2 and β-carotene) and tocopherols α, β and γ**[3]**. It is cultivated on 800,000 ha in the world, with a yield of between 650,000-921,000 tons [**4, 5]**.

Many factors including genotype, environmental conditions and cultural practices are impacted on the each of yield components and their relationship and seed yield of safflower, among the most cultural practices: nutrient management is one of the critical enhancing high safflower producing **[7]**. It is frequently reported that the seed yield and seed oil contain increased with application of chemical fertilizer application **[11]**.However, recently general concern has been raised about possible environmental pollution caused by excessive apply of chemical fertilizer **[12]** and the demand for organic agriculture led to the use of organic fertilizers as the alternative plant nutrition and ensure the soil sustainability. There are many organic fertilizer sources that used in agriculture **[13]**.such as animal manure derived from cows, chickens, goats manures and compost derived from agricultural that is waste organic material such as

corn stalks or decomposed, waste straw **[14]** . wood ash, spent grain, rice bran, and sawdust **[15]**. Organic fertilizers enhance the soil structure, chemistry, and biological activity of the soil by providing nutrients and improve the quality of soil**[16]** by increasing the microorganism activity, anion and cation exchange capability, organic matter, carbon-content of soil **[17]**, enhancing water retention and resistance to erosion. Organic fertilizers provide nitrogen in a usable form, which improve plant growth while at the same time neither cause burning of roots nor dispatch beneficial micro-organisms in the soil and improving plant tolerance**[24]** .However, there no literature available about the effect of compost compared to inorganic fertilizer on the growth, seed yield and seed oil content and it quality in oil crops. Therefore, this study was designed the investigate the effect of compost and inorganic fertilizer on safflower physiology, growth, yield components, seed yield, and seed oil content under rain fed condition in Sulaimani region,

Materiala and Method

The study was carried out at Qlyasan Agricultural Research Station, College of Agricultural Engineering Sciences, University of Sulaimani (Lat 35 º 34' 307"; N, long 45º 21' 992; E, 765 masl), 2km North West of Sulaimani city. The three factors experiment designed according to Factorial Randomized Complete Block Design (RCBD) during winter season with three replications each replicate consisted of 12 plots. The area of each plots was 2 m^2 with five rows (1 meter long) for each plot the space between rows was 0.5 m with 30 cm space between plants. Treatment layout was two varieties (Gilla and Russi) of safflower obtained from the Agricultural Research Center at Bakrajo, Sulaimani. The seeds was sown on 21st Decembers 2023 the 24 plants in each plots and two types of fertilizer: three levels (0, 60 and 120 kg ha^{-1}) of balanced (NPK 20:20:20) as the chemical fertilizer and three levels (0, 6 and 12 ton. ha^{-1}) of compost (Hassora) obtained from Sahand Company. Iran, as the organic fertilizer. The fertilizers were applied one time with sowing the seeds. All cultural practices were conducted as usual for rain fed cultivation. The analysis of soil were conducted in the natural resource department- college of agricultural engineering Sciences and the physical and chemical analysis of the soil shown in Table1 the soil texture is silt clay, with an organic matter of and a PH of 7.59 and the nutrient content of compost (organic fertilizer) is presented in Table 1.The metrological data is presented in Figure1.

Table (1): Soil characteristics of the experimental site and nutrient values of organic fertilizer named Hassora produced by Sahand Company.

Physiochemical	Properties	Values	Nutreint content of plant compost	Values
Physical properties	Sand	59.68	Nitrogen %	7
	Salt	619.17 g.k g^{-1}	Phosphor %	1
	Clay	321.15	Soluble Sodium %	0.5
	Texture	Salty clay	Soluble Calcium %	0.2
	pH	7.59	Organic carbon %	17
	Ec	490 µS cm^{-1}	Ec	4.9
Chemical Properties	O.M	22.4 g.kg^{-1}	pH	8.2
	Caco3	304.3 g. kg^{-1}		

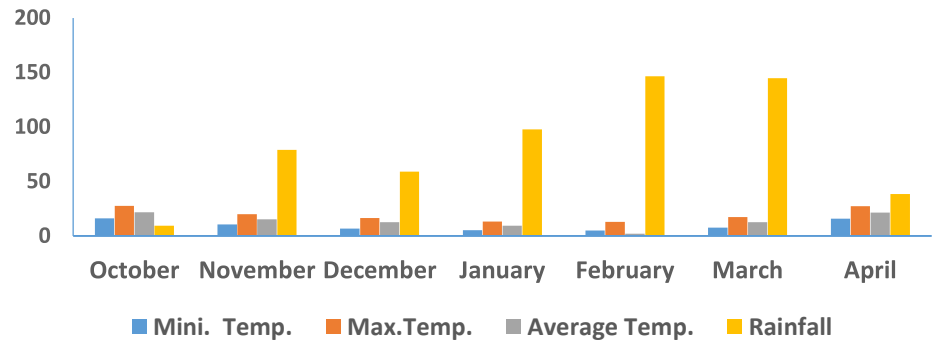


Figure (1). Average air temperature and rain fall data during the experimental period at the experimental farm from October, 2023 to April, 2024.

At anthesis the five plants from each plot randomly were chosen the growth traits (plant height (cm), No.of leaves plant^{-1}, No. of branches plant $^{-1}$, leaves total chlorophyll content (µgg^{-1}) using the CCM – 200 Clorophyll Content Meter by Opti – Science, LAI (divide plant leaves total area by ground area) , leaves dry weight (g) and stem dry weight (g)) were measured.

At harvest the yield components (No.of capitulum plant^{-1}, weight of capitulum plant^{-1} (g), No.of seed capitulum $^{-1}$, seed weight capitulum^{-1} (g) and 1000 seed weight (g) and seed oil percentage were measured. The homogenized dry seed was extracted with petroleum ether using soxhelet extracts to determine the seed oil content, and the oil percentage was calculated as % oil = w2- w1/ sample weight x 100 according to **[6].**

STATISTICAL ANALYSIS

The analysis of variance factorial (ANOVA) was conducted as a general test of the effects of organic and inorganic fertilizer, levels fertilizer treatments, and safflower varieties on growth, yield and its components and seed oil content. The LSD test ($p \leq 0.05$) was performed for the comparison between mean values. SPSS software was utilized to analyze the data.

Results

Plant growth traits at Anthesis

Data presented in Table 2 show that both varieties (Gilla and Russi) had significantly taller plants, stem dry and leaves dry weight under NPK fertilizer compared to compost. However, highest No. of branches was recorded for both varieties under compost with highest No.of leaves for Gilla under compost but for Russi variety highest No.of leaves was under NPK fertilizer. No significant differences were recorded in total leaf chlorophyll content and LAI in both varieties under both compost and NPK fertilizers. All mentioned studied growth traits significantly increased with increasing levels of both fertilizers applied compared to control as shown in Table 2.

In general, the results in Figure 2 In comparison to compost, both varieties under the NPK fertilizer had significantly taller plant, LAI, No. of branches; stem dry weight and leaves dry weight with no significant differences between plant leaves total chlorophyll contents under both fertilizers used.

As shown in Figure 3 Gilla variety was significantly taller and produced more branches as compared to Russi variety. Wiliest, Russi variety recorded significantly higher LAI and stem dry weight compared to Gilla variety. Both varieties had same total chlorophyll content, No. of leaves and leaves dry weight. The interaction effects between safflower varieties and fertilizers types and their levels on growth traits shown in Table.3: and the data revealed that the highest plant height 126.330 cm, 124.330 cm and 120 cm for Gilla under 60 kg. ha^{-1} and 120 kg. ha^{-1} NPK and 12 ton. ha^{-1} compost respectively, compared to other treatments. However, the tallest plant for Russi plant was 116 cm was under the highest level of both types of fertilizers 120 kg. ha^{-1} NPK and 12ton. ha^{-1} compost respectively. Under both types of fertilizer the highest value of LAI was recorded for Russi variety compared to Gilla, which was the highest value of 4.230 LAI under 120 kg. ha^{-1} followed by 3.370 LAI under 60kg. ha^{-1} and then 3.300 and 3.200 LAI under 12ton. ha^{-1} and 6 ton compost, respectively. The total leaves chlorophyll content (µg/g), No. of branches plant^{-1} and stem dry weight (g) were no significantly differ between all treatments. Both varieties produced significantly the highest No leaves plant^{-1} with values of 92.660 and 91.660 for Russi and Gilla

Table (2). Safflower varieties under organic (compost) and inorganic (NPK) fertilizers and their different levels.

Varieties	Types of Fertilizers	Plant height (cm)	Total chlorophyll (µgg^{-1})	LAI	No. of branches plant^{-1}	No. of leaves plant^{-1}	stem dry weight (g)	Leaves dry weight (g)
Gilla	Compost	93.38	52.188	1.611	6.590	61.330	12.60	3.270
	NPK	108.44	53.297	1.580	6.370	71.550	17.19	3.940
Russi	Compost	91.870	50.952	3.070	5.880	75.660	22.65	3.190
	NPK	93.400	53.708	3.570	4.660	57.770	49.90	3.910
LSD ($p \leq 0.05$)		5.210	N.S	N.S	0.470	4.030	1.590	N.S
varieties *levels of fertilizers								

Gilla	0	74.750	48.550	1.250	5.770	47.660	7.740	2.580
	6ton. ha^{-1} 60 kg. ha^{-1}	105.750	47.983	1.900	6.660	63.330	14.580	3.730
	12 ton. ha^{-1} 120 kg. ha^{-1}	122.250	61.693	1.640	7.000	88.330	22.430	4.510
Russi	0	72.660	43.083	2.840	4.000	47.000	11.930	2.430
	6 ton.ha^{-1} 60 kg. ha^{-1}	88.830	52.493	3.490	6.000	75.330	25.340	4.270
	12 ton. ha^{1} 120 kg. ha^{-1}	116.280	61.413	3.630	5.830	77.830	34.050	3.950
LSD (p≤0.05)		6.380	4.205	4.205	0.570	4.940	1.940	0.410
		Types of fertilizer*Levels of fertilizers						
Compost	0	73.750	47.400	2.080	4.880	47.330	9.920	2.340
	6 ton. ha^{-1}	85.660	46.262	2.300	7.000	66.000	18.200	3.420
	12 ton. ha^{-1}	118.350	61.048	2.620	6.830	91.160	24.830	3.930
NPK	0	73.660	44.233	2.000	4.880	47.330	9.570	2.670
	60 kg. ha^{-1}	108.910	54.215	3.080	5.660	72.660	21.720	4.580
	120 kg. ha^{-1}	120.180	62.058	2.650	6.000	74.000	31.650	4.520
L.S.D (p≤0.05)		7.080	3.433	3.433	0.470	4.030	1.590	0.340

respectively under 12 ton ha^{-1} compost, followed by 85.000 and 82.000 for Gilla under 120 kg. ha^{-1} and 60 kg ha^{-1} NPK respectively. However, both varieties accumulated significantly biggest dry matter in their leaves under 120 kg. ha^{-1} and 60 kg. ha^{-1} NPK followed by 12ton.ha compost with values of 5.060 g , 4.25g and 3.650 g for Russi with 4.800g, 4.110g and 4.220g for Gilla under 120 , 60 kg ha^{-1} NPK and 12ton.ha compost, respectively. Finally, the lowest values of each of growth traits was recorded for no fertilizer (control) treatments as shown in Table 3.

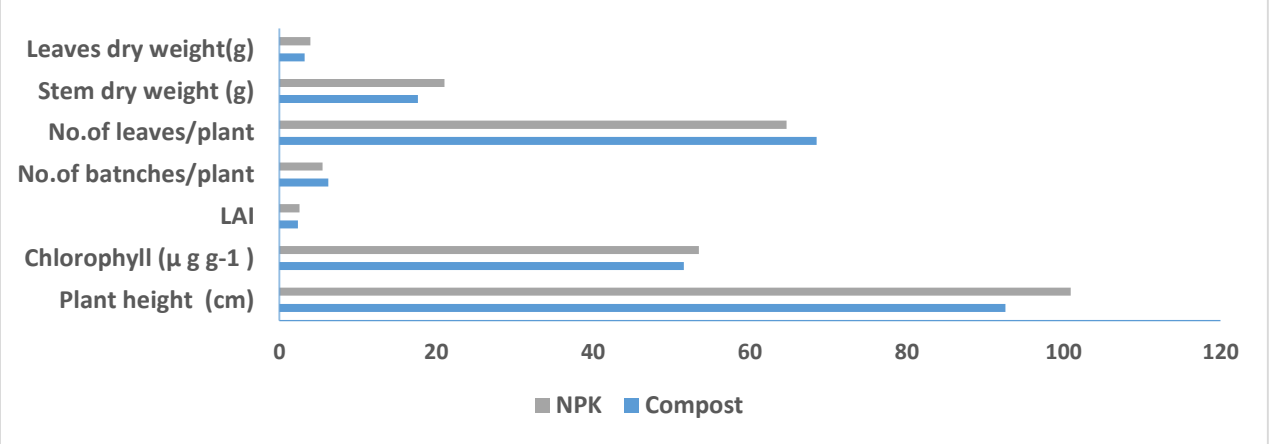


Figure (2). The comparison between two fertilizer types (NPK and compost) effects on safflower growth traits at anthesis.

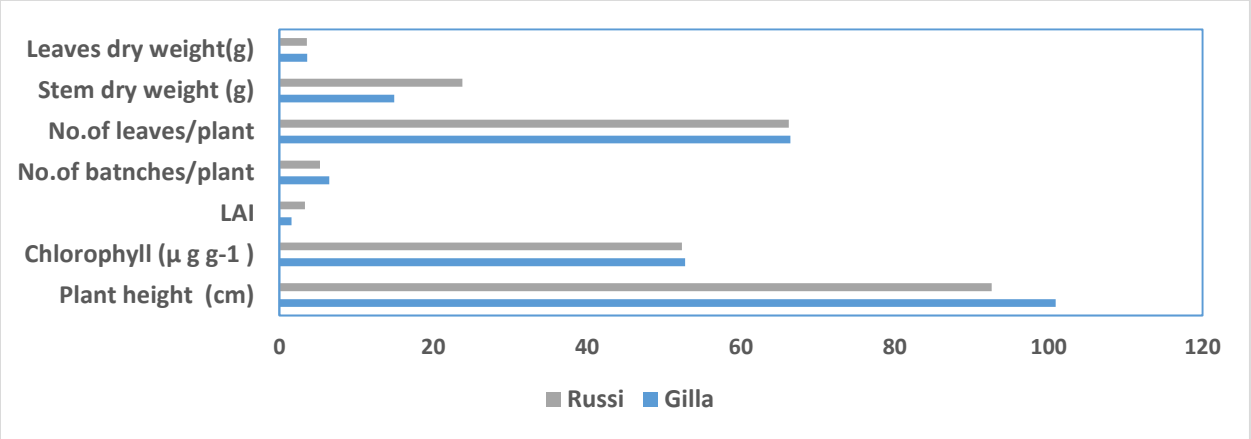


Figure (3). The comparison between two safflower varieties growth traits at anthesis under the both fertilizers applied.

Table(3): The interaction effects of safflower varieties and two types (organic and inorganic) of fertilizers and their levels on growth traits at anthesis

Varieties	Types of Fertilizer	Levels of fertilizers	Plant height (cm)	chlorophyll(µgg^{-1})	LAI	No. of branches plant^{-1}	No. of leaves plant^{-1}	Stem dry weight (g)	Leaves dry weight (g)
Gilla	Compost	Control	74.830	51.717	1.250	5.770	47.660	7.740	2.250
		6 ton ha^{-1}	85.160	43.527	1.350	7.000	44.660	12.11	3.350
		12 ton ha^{-1}	120.160	61.320	2.220	7.000	91.660	18.00	4.220
	NPK	Control	74.660	45.383	1.250	5.770	47.660	7.740	2.910
		60 kg ha^{-1}	126.330	52.440	2.440	6.330	82.000	17.00	4.110
		120 kg ha^{-1}	124.330	62.067	1.060	7.000	85.000	26.78	4.800
Russi	Compost	control	72.660	43.083	2.920	4.000	47.000	12.10	2.430
		6 ton ha^{-1}	86.160	48.997	3.260	7.000	87.330	24.20	3.490
		12 ton ha^{-1}	116.530	60.777	3.300	6.660	92.660	31.58	3.650
	NPK	Control	72.660	43.083	2.760	4.000	47.000	11.77	2.430
		60 kg ha^{-1}	91.500	55.990	3.730	5.000	63.330	26.93	5.060
		120 kg ha^{-1}	116.030	62.050	4.230	5.000	63.000	36.53	4.250
L.S.D ($p \leq 0.05$)			9.030	N.S	0.220	N.S	6.980	N.S	0.580

Yield and yield components at maturity

Table 4 show the no significant differences between both varieties in No.of capitulum plant^{-1}, weight of capitulum plant^{-1} (g) and seed yield kgha^{-1} under both compost and NPK fertilizers applied. However, there were a significant differences between both varieties under both fertilizers used in No.of seed capitulum^{-1}, seed weight capitulum^{-1} (g), 1000 seed weight (g) and oil%, for example Russi variety produced highest No.of seed under NPK and compost compared to Gilla under both fertilizers. However, the highest seed weight capitulum (g) and 1000 seed weight (g)

was produced by Gilla under NPK and compost and was no significantly differ from Russi under NPK only as shown in Table 4 The significantly highest oil% produced by Russi under compost compared to other treatments. Whilst, both varieties produced same amount of oil% under NPK and the lowest was produced by Gilla under compost. Seed yield kg.ha^{-1} and all mentioned yield components were significantly increased with increasing the levels of both fertilizers used except of No. of seed capitulum^{-1} and weight of seed/capitulum which were no significantly differ between all levels of both fertilizers used.

In general, under both fertilizers applied Russi variety was superior above Gilla in the seed yield kg. ha^{-1} and all mentioned yield components (No.of capitulum/plant, weight of capitulum plant^{-1} (g), No.of seed capitulum^{-1}) and seed oil percentage expect of seed weight capitulum $^{-1}$ (g) and 1000 seed weight (g) which were no significantly differ between both varieties as shown in Figure.4.

Figure 5 show that the plants under NPK fertilizer produced significantly highest seed yield kg. ha^{-1} and all mentioned yield components (No.of capitulum plant^{-1}, weight of capitulum plant^{-1} (g), seed weight capitulum^{-1} (g) and 1000 seed weight (g) and seed oil percentage compared to compost, expect of No.of seed capitulum $^{-1}$and seed oil% which were no significantly differ at both fertilizers used.

Finally, the interaction effects between both varieties and the levels of both fertilizers applied on seed yield and kg.ha^{-1} all mentioned yield components presented in Table 5 the data indicated the significant differences between all treatments. The highest No.of capitulum plant^{-1} 36.260 and 35.280 was recorded for both varieties under 120 kg. ha^{-1} NPK followed by 35.360 and 34.00No.of capitulum plant^{-1} for Russi under 6 tonha^{-1} and 60 kg. ha^{-1} NPK respectively, with 31.210 and 28.060 No.of capitulum ha^{-1} for Gilla under 12ton ha^{-1} compost and 60kg ha^{-1} NPK respectively.

The lowest value of 23.030 No.of capitulum plant^{-1} was recorded for Gilla under 6 ton ha^{-1} compost compared to all above mentioned data except of no fertilizer (control) treatment.

The highest weight of capitulum plant^{-1} (g) of 40.160 g was recorded for Russi under 120NPK kg.ha^{-1} which was no significantly differ from 35.130 for Russi under 60 kg. ha^{-1} NPK and 41.360g for Gilla under 60 kg ha^{-1} NPK followed by 34.090g for Gilla under 120 kg. ha^{-1} and 31.320g for russi under 12ton. ha^{-1} compost with 29.920g for gilla under 120 kg. ha^{-1} compost. The lowest value of 22.240g was for Gilla under 8ton ha^{-1} compared to other treatments.

Russi variety recorded highest No.of seed capitulum^{-1} with value of 26.880 and 25.640 under 120 kg ha^{-1} NPK and 8ton ha^{-1} compost respectively compared to other treatments. Also the highest weight of seed/capitulum (g) with value of 1.570g was recorded for Russi under 120 kg ha^{-1} NPK followed by 0.900g and 0.920g for Gilla under 120 kg ha^{-1} NPK and 12 ton ha^{-1} compost respectively compared to other treatments. The highest 1000 weight of 50.46g and 54.00g were obtained from Gilla plants under 120 kg ha^{-1} NPK and 12ton ha^{-1} compost respectively. Followed by 42.933 g, 42.900 g and 39.133 g from Russi variety under 120 kg ha^{-1}, 60 kg ha^{-1} NPK and 12 ton ha^{-1} compost respectively compared to other treatments.

The greatest seed yield kg ha^{-1} of 973.867 kg ha^{-1} and 923.733 kg/ha was recorded for Russi under 120 kg ha^{-1} NPK and 12 ton. ha^{-1} compost respectively with 944.733 kg. ha^{-1} for Gilla under 120 kg. ha^{-1} NPK compared to other treatments. Finally, the highest seed oil% was produced by Russi with value of 28.833% and 27.833% under 120 kg. ha^{-1} NPK and 12 ton. ha^{-1} compost compared to other treatments.

Table (4): Safflower seed yield and its components under Organic (compost) and inorganic (NPK) fertilizers and their different levels.

Varieties	Fertilizers	No. of Capitulump lant^{-1}	Wight of capitulum plant^{-1} (g)	No. of seed capitulum^{-1}(g)	Wight of seed capitulum^{-1}(g)	1000 seed weight (g)	Seed yield (kg ha^{-1})	oil %
Gilla	Compost	23.580	22.330	18.640	0.710	35.211	531.600	23.887
	NPK	26.620	30.100	15.820	0.740	23.967	625.911	24.600
Russi	Compost	27.720	29.140	20.760	0.620	29.678	622.578	25.500
	NPK	30.980	34.320	21.730	0.950	38.067	695.956	24.933
L.S.D (p≤0.05)		N.S	N.S	1.660	0.180	3.344	N.S	0.661
Varieties *levels of fertilizers								
Gilla	0	16.510	14.850	13.380	0.620	19.800	307.667	21.800

	6 ton. ha^{-1} 60 kg. ha^{-1}	25.550	31.800	18.110	0.660	31.733	579.833	24.733
	12 ton. ha^{-1} 120 kg. ha^{-1}	33.240	32.000	20.210	0.910	52.233	848.767	26.197
Russi	0	22.690	27.660	16.220	0.500	28.367	282.667	22.317
	6 ton. ha^{-1} 60 kg. ha^{-1}	34.680	31.780	23.870	0.720	32.47	746.333	25.000
	12 ton. ha^{-1} 120 kg. ha^{-1}	30.680	35.450	23.660	1.410	41.033	948.800	28.333
L.S.D (p≤0.05)		3.720	4.800	N.S	N.S	4.095	49.939	0.809
	Types of fertilizer*Levels of fertilizers							
Compost	0	19.600	21.250	14.800	0.560	24.083	303.500	22.317
	6 ton. ha^{-1}	29.190	25.330	22.930	0.630	26.683	589.500	24.983
	12 ton. ha^{-1}	28.160	30.620	21.380	0.810	46.567	838.267	26.780
NPK	0	19.600	21.250	14.800	0.560	24.083	286.833	21.800
	60 kg. ha^{-1}	31.030	38.240	19.040	0.750	37.267	736.667	24.750
	120 kg. ha^{-1}	35.770	37.130	22.490	1.230	46.700	959.300	27.750
L.S.D (p≤0.05)		3.040	3.920	1.660	0.180	3.344	40.775	0.661

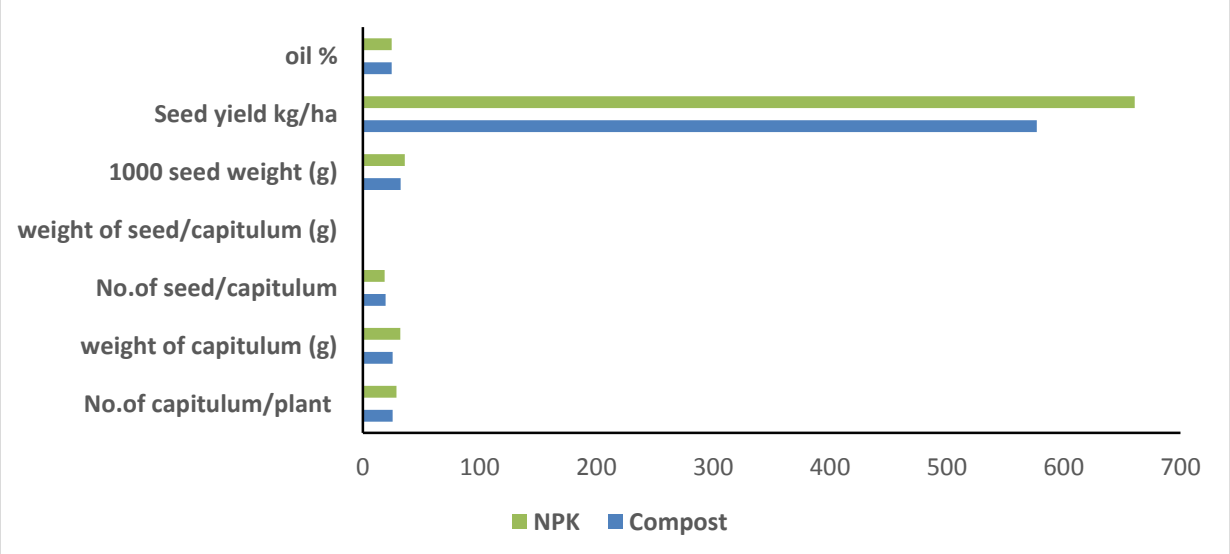
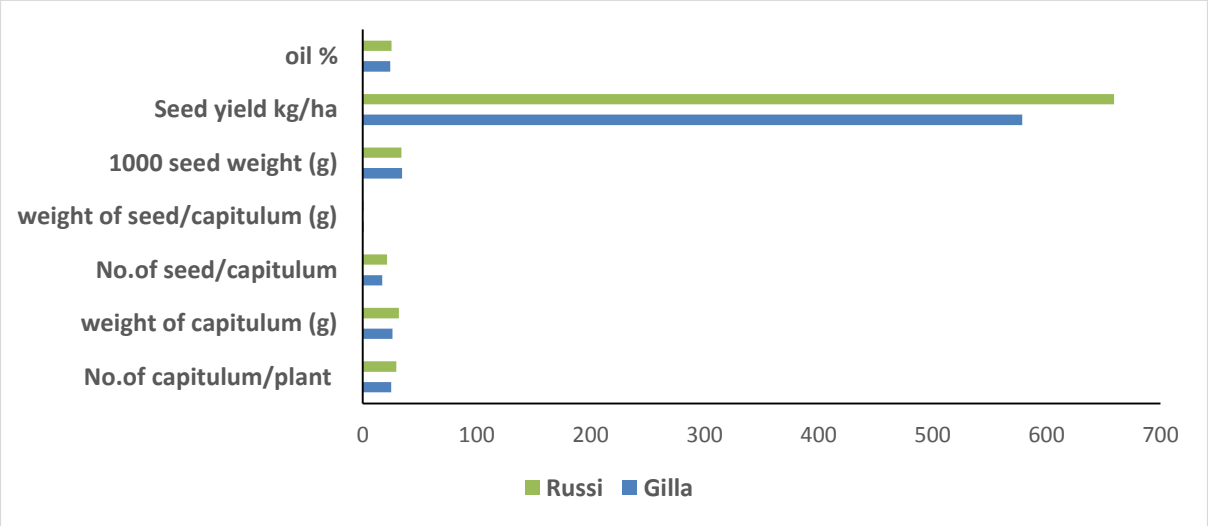


Figure (4). The comparison between two fertilizer types (NPK and compost) effects on safflower seed yield, its components and oil% at maturity.



Figure(5). The comparison between two safflower varieties seed yields its components and oil% at maturity under the both fertilizers applied

Table (5): The interaction effects of safflower varieties and two types (organic and inorganic) of fertilizers and their levels on seed yield ant its components at maturity.

Varieties	Fertilizers	Levels of fertilizers	No. of Capitulm plant^{-1}	Wight of capitulm^{-1}plant (g)	No. of seed capitulum plant^{-1}	Wight of seed capitulum^{-1}	1000 seed weight (g)	Seed yield (kg ha^{-1})	oil %
Gilla	Compost	Control	16.510	14.850	13.380	0.620	19.800	307.667	21.80
		6 ton ha^{-1}	23.030	22.240	20.220	0.600	31.833	534.333	24.13
		12 ton ha^{-1}	31.210	29.920	22.330	0.920	54.000	752.800	25.72
	NPK	control	16.510	14.850	13.380	0.620	19.800	307.667	21.80
		60 kg ha^{-1}	28.060	41.360	16.000	0.720	31.633	625.333	25.33
		120 kg ha^{-1}	35.280	34.090	18.090	0.900	50.46	944.733	26.66
Russi	Compost	Control	22.690	27.660	16.220	0.500	28.367	299.333	22.833
		6 ton ha^{-1}	35.360	28.430	25.640	0.670	21.533	644.667	25.833
		12 ton ha^{-1}	25.110	31.320	20.440	0.700	39.133	923.733	27.833
	NPK	Control	22.690	27.660	16.220	0.500	28.367	266.000	21.800
		60 kg ha^{-1}	34.000	35.130	22.090	0.780	42.900	848.000	24.167
		120 kg ha^{-1}	36.260	40.160	26.880	1.570	42.933	973.867	28.833
L.S.D ($p \leq 0.05$)			5.270	6.790	2.870	0.320	5.791	70.624	1.144

Discussion

This study clearly confirmed that, in comparison to compost, both varieties under the NPK fertilizer had significantly taller plant, LAI, No. of branches; stem and leaves dry weight with no significant between in total chlorophyll content. This may be due to sufficient amount of nitrogen, phosphorus and potassium in NPK fertilizer which nitrogen and phosphorus directly involved in cell multiplication and strong root system development for effective nutrient absorption**[18]**. Nitrogen is one of the main components of organic compounds such as amino acids, proteins, and nucleic acids and its necessary for vegetative and reproductive stages phonological development **[19]** . Applying the adequate amount of nitrogen fertilizer can significantly increase biomass, and also greatest biomass is only possible under sufficient nitrogen fertilization conditions**[20]** Phosphorus nutritious element has a fundamental role in several physiological mechanisms such as, respiration, photosynthesis, energy storage and transfer, cell division

and enlargement .**[21]** A right amount of potassium supply helps all of these processes and transportation systems maintain for example; potassium is responsible for proper functioning of stomata which are essential for photosynthesis, water and nutrient transport **[22]**. The current study approved that , the balanced NPK fertilizer is necessary for plant growth, yield and quality **[23]**. And all mentioned growth parameters LAI, No.of leaves, No.of branches, leave and stem dry matter were significantly increased with increasing the levels of NPK fertilizers to 120 kg.ha-^{1} This might be due to greater absorption and translocation of nutrient. Similar results were reported by **[24]**.
As mentioned earlier the proper growth traits and under the fertilizer were significantly increased in the current study resulted in significantly increase in the; No.of capitulum plant^{-1}, No.of seed capitulum $^{-1}$,Seed weight per capitulum $^{-1}$, 1000 seed weight and seed yield kgha^{-1} this might be due the larger leaf area which resulted in more photosynthetic rate and more dry matter accumulation and translocation to reproductive parts and consequently increased seed yield[24]. Similar results was conformity by **[26]**. In this experiment the variety of Russi performed better than Gilla variety under all fertilizer treatments, the leaf area and LAI which is the important growth characters greater in Russi than Gilla variety resulted in larger photosynthesis activities and more assimilates resulted in better dry matter accumulation and translocated of dry matter to reproductive parts which also reflecting towards dominance in No.of capitulum plant^{-1} , No.of seed capitulum^{-1}, weight of seed capitulum^{-1} which finally resulted in higher seed yieldkgha-^{1} in Russi than Gilla variety. These results was similar with finding by**[10]** . This might be due to the genetic potential of each varieties same result was documented by**[27]**. As mentioned earlier, the impact of inorganic fertilizer better than that of organic fertilizer for example tallest plant, highest leaves dry weight were obtained from those plants under NPK fertilizer because inorganic fertilizer contains all essential elements that plants can quickly and in a short time absorbed [14] .
However, in this study the both varieties produced significantly the highest No.of branches and leaves dry weight under 12 ton compost which was par with 120kg.ha^{-1}NPK fertilizer and the highest seed yieldkg.ha^{-1} and its yield components (No.of capitulum plant^{-1}, weight of capitulum plant^{-1}, No.of seed capitulum^{-1}, weight of seed capitulum^{-1}, 1000 seed weight) and oil% were obtained by Russi variety under 12 ton ha^{-1} compost which par with 120kgha $^{-1}$. This means that compost fertilizer enhanced soil nutrient availability by releasing nutrient at a slower rate and its impact greatly has appeared at the branching stage of safflower plant growth. Also as shown in Figure 1 the soil temperature and moisture content was not sufficient for mineralization of organic compost at the earlier stages of plant growth. Because the aerobic microbial activity dependent on several factors such soil temperature, and moisture content and the nature of organic fertilizer sources **[28]** the optimal aerobic microbial activity is at the soil moisture content ranging between 50% and 70% of the water holding capacity**[29]**, and the temperature maintained between 20 and 28 ^{0}C **[30]**.

Conclusion

The present study concluded that, the application of large amount of inorganic fertilizer NPK and organic fertilizer (compost) can significantly improve the growth performance of safflower and consequently increase the seed yield and seed oil content. The outcomes indicate the use of 12 ton.ha^{-1} par with 120 kg.ha^{-1} NPK for Russi variety seed yield and seed oil content under the rain fed condition. However, the other experiment should be under taken include other safflower varieties and should be repeated for several years to suggest exactly weather the eco- friendly organic (compost) or inorganic fertilizer is better for safflower to produce economic seed and oil yields under rain fed condition.

Supplementary Materials

No Supplementary Materials.

Funding

This research received no external funding.

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تأثير الأسمدة العضوية (الكمبوست النباتي) والأسمدة غير العضوية على صفات النمو والإنتاجية ومحتوى الزيت في بذور العصفر *(Carthamus tinctorius L.)*

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الخلاصة

تم إجراء تجربة حقلية خلال عام 2023-2024 في محطة أبحاث قلياسان ، كلية علوم الهندسة الزراعية، جامعة السليمانية. تم تنفيذ التجربة لتحديد تأثير نوعين من الأسمدة: الأسمدة العضوية (الكمبوست النباتي) والأسمدة غير العضوية ***(NPK)*** بنسبة 20:20:20 على نمو محصول العصفر ***(Carthamus tinctorius L.)*** وإنتاجية البذور والنسبة المئوية للزيت.

تضمنت المعاملات صنفين من بذور العصفر (***Russi,Gilla***) مع ثلاث مستويات من السماد العضوي (0، 6، و12 طن. هـ$^{-1}$ من الكمبوست النباتي)، وثلاث مستويات من السماد غير العضوي (***0*** ، 60، و120 كغم. هـ$^{-1}$***NPK)***. أظهرت النتائج أن من بين صفات النمو، تم تسجيل أعلى مؤشر مساحة ورقية ***(LAI)*** للصنف "روسي" تحت مستوى 120 كغم.ه$^{-1}$ من سماد***NPK*** ، بينما اعلى ارتفاع للنبات كانت للصنف "***Gelli***" تحت مستويي السماد 60 و120 كغم. ***NPK***. هـ$^{-1}$ ، مقارنة بالمعاملات الأخرى، دون وجود فروق معنوية بين المعاملات في صفات محتوى الكلوروفيل الكلي لأوراق النبات وعدد الافرع والوزن الجاف للساق.

ومع ذلك، أظهرت كلا الصنفين أعلى عدد من الافرع تحت المعاملة 12 طن. هـ$^{-1}$ من الكمبوست، وأعلى وزن جاف للأوراق تحت 120 كغم. ***NPK***.هـ$^{-1}$ و12 طن. كمبوست. هـ$^{-1}$ ، مقارنة بالمعاملات الأخرى. أعلى إنتاجية بذور (كغم. هـ$^{-1}$) ومكوناتها (عدد الكبسولات/نبات، وزن الكبسولة، عدد البذور/الكبسولة، وزن البذور/كبسولة، ووزن ألف بذرة) تم الحصول عليها من الصنف "***Russi***" تحت مستويي 60 و120 كغم. ***NPK*** .هـ$^{-1}$ و12 طن. كمبوست. هـ$^{-1}$ ، بالإضافة إلى أعلى نسبة زيت من نفس الصنف وتحت نفس المعاملات.

تشير هذه الدراسة إلى أن استخدام 12 طن. هـ$^{-1}$ من الكمبوست للصنف "***Russi***" تحت ظروف الزراعة الديمية مع 120 كغم. هـ$^{-1}$ من سماد ***NPK*** يمكن أن يعطي أفضل حاصل بذور ونسبة الزيت.

الكلمات المفتاحية: محصول العصفر، كمبوست نباتي، NPK، إنتاجية.