



## Effect of Roselle Leaves Extract and Bio-Fertilizer (EM1) on Growth and Yield of Sunflower (*Helianthus annuus* L.)

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**Abstract:** A field experiment was conducted at the Al-Muhanniyah during the 2019 autumn season to study the effect of spraying Roselle leaf extract and EM1 (Effective Micro Organisms) on two genotypes of sunflower. (Shumus Iraqi and Flamy Belgian), for the three concentrations of Roselle leaf (0, 15, 25, 35%) in addition to the control treatment and three concentrations of bio-fertilizer (EM1) (0, 3, 4, 5) g L<sup>-1</sup> were evaluated. The Genotypes Shumus excelled in all traits (plant height, number of leaves, leaf area, number of seeds per head, the 1000 seeds weight, total seed yield). Roselle leaf extract was resulted in plant height, number of leaves, leaf area, and number of seeds per head). EM1 bio-fertilizer excelled in 1000 seeds weight and the total yield with highest averages of 60.31 g and 4.291 tons per ha. The combination 25% Roselle leaf extract x Shumus cultivar was significantly better with the highest averages for the traits plant height, number of leaves, leaf area, number of seeds per head while the combination 4g L<sup>-1</sup> EM1 x Shumus cultivar resulted in the highest averages of 1000 seeds weight and total seed yield (76.30 g and 6.30 kg per ha).

**Keywords:** Flamy, Roselle plant, Shumus, Sunflower

The sunflower crop, *Helianthus annuus* L., is one of the important economic crops in Iraq but the productivity is low. The adoption of agronomic practices including nutrient, water and pest management significantly affect the productivity. The use of fertilizers and growth regulators or their alternatives, such as plant extracts improve the sunflower growth and production (Al-Jubouri et al 2007). The addition of roselle leaf extract to sunflower, increase the chlorophyll content in leaf and conserve the moisture (Alik 2007). Roselle leaf extract contains effective antioxidants like ascorbic acid and contains nutrients: sodium, calcium, manganese, magnesium, iron, potassium, In addition, also contains gossypetin, hibiscin chorideare, thiamine, riboflavin and niacin (Mahadevan and Kamboi 2009). The use of chemical fertilizers has detrimental effect on environment. The emphasis is to find a suitable and environmentally friendly alternative to improve the physical, chemical and biological properties of soil to facilitate the absorption of elements from the soil and impart the biological resistance to some pests and diseases. Microorganisms are also considered as one of the alternatives to improve soil properties and prevent the growth of many viruses and reduce the use of chemical fertilizers and insecticides (David et al 2008). The present study was conducted to evaluate the effect of roselle leaves extract and bio-Fertilizer on growth and yield of Sunflower.

### MATERIAL AND METHODS

A field experiment was conducted at the Al-Muhannawi Extension Center during 2019, to observed the effect of adding EM1 (effective micro-organic) at three levels (3, 4, 5 ml.L<sup>-1</sup>) .in addition to the control. The spraying the roselle leaf extract was done at the concentrations of 15, 25 and 35 per cent. The study was done on two of sunflower cultivars e (Shumus and Flamy). Soil samples were taken from the field soil with a depth of 0 - 30 cm and for physical and chemical properties (Table 1).

The plants were sprayed with Roselle leaf, three times 15 and 30 days after germination and at flowering. EM1 bio-fertilizer, h contains effective non-GMO microorganisms and is free of harmful chemicals. The cultivars (Shumus and Flamy) were cultivated with distance of 75 cm row to row and 25 cm plant to plant cm. The recommended agronomic practices were followed. The experiment was conducted according to the randomized complete block design in factorial lay out with three replicates. The data was collected on plant height number of leaves per plant from 10 plants in each plot. The leaf area for all ten plant leaves was calculated for each experimental unit according to the following formula: LA = 0.6 w. (El- Sahookie 1982). Number of seeds per head and weight of 1000 seeds were taken from the rom the ten plants.

The seeds were collected for the ten plants taken at full maturity and the seeds were brushed by hand and then dried.

The weight of the crop is corrected on the basis of 8% moisture and multiplied by the plant density which is 53333 to estimate total seed yield.

## RESULTS AND DISCUSSION

**Plant height (cm):** The plant height was significantly higher in Shumus cultivar (201.58 cm) as compared to Flamy (160.17 cm). The Roselle plants significantly more plant height (186.15 cm) as compared with bio-fertilizer, while (170.55 cm). The concentration of 25% of the Roselle leaf extract and gave the highest average height of 212.42 cm than the rest the concentrations, while the control the minimum plant height (155.52 cm). The concentration gave 4 ml L<sup>-1</sup> of bio fertilizer EM1, resulted in maximum plant height (196.32 cm), while the control treatment gave the lowest plant height (153.44 cm). As for the interaction between the cultivars and the treatments, the treatment (25% Roselle plant and Flamy cultivar) gave the highest average of 231.39 cm, while the treatment (0% Roselle plant) was the lowest of

the averages of 128.82 cm. This can be explained by the fact that the Roselle plant extract increased the efficiency of plant absorption of nutrients.

**Number of leaves (leaf per plant):** The number of leaves in Shumus cultivar was significantly higher (28 leaves per plant) as compared to Flamy cultivar (24.75 leaf per plant). EM1 bio-fertilizer gave the lowest average of 25.50 leaves per plant. The concentration 25% of Roselle excelled on the rest of the concentration (31 leaf per plant) (Table 3) while control treatment gave the lowest average of 23.50 leaf per plant). The bio-fertilizer at 4 ml.L<sup>-1</sup> resulted in higher number of leaves per plant (28.50 leaf plant) than in control (22 leaf plant). The 25% Roselle plant x shumus cultivar gave the highest averages of 33 leaf per plant.

**Leaf area (m<sup>2</sup>):** The Shumus cultivar significantly excelled on leaf area with average of 1.207m than Flamy cultivar (1.106 m<sup>2</sup>) (Table 4). Roselle plant extract was significantly better than the EM1 bio-fertilizer with average of 1.179 m<sup>2</sup>, while the area was lowest in bio-fertilizer (1.134 m<sup>2</sup>). The concentration of 25% of the Roselle plant extract excelled than the rest concentrations (1.435 m<sup>2</sup>). The control treatment gave the lowest averages of 0.782 m<sup>2</sup>. The concentration 4 ml.L<sup>-1</sup> of EM1 gave the highest average of 1.371 m<sup>2</sup>, while control treatment lowest of 0.727 m<sup>2</sup>. This can be explained by the fact that the leaf extract contains anthocyanins which are highly effective in containing free radicals and levels of moisture in the environment. (Ali et al 2005) because of the presence of ascorbic acid where is major component in the extract and also increase the efficiency of anti-oxidant enzymes in addition to the phenols that work is an anti-

**Table 1.** Physical and chemical traits of soil (2019)

Components	Quantity
Sand	184 g per Kg
Silt	533 g per Kg
Clay	287 g per Kg
Texture	Silt clay loam
Nitrogen	117 mg per Kg
EC	4.2 Ds.m-1
pH	7.32

**Table 2.** Effect of Roselle leaf extract and bio-fertilizer EM1 on plant height in sunflower (cm)

Treatments	Concentrations	Shumus cultivar	Flamy cultivar	Average	
Roselle leaf extract	0%	182.22	128.82	155.52	
	15%	197.43	153.89	175.66	
	25%	231.39	193.44	212.42	
	35%	217.39	184.60	200.99	
Average		207.11	165.19		
Bio-fertilizer	0 ml L <sup>-1</sup>	173.49	133.40	153.44	
	3 ml L <sup>-1</sup>	182.62	151.81	167.22	
	4 ml L <sup>-1</sup>	220.47	172.17	196.32	
	5 ml L <sup>-1</sup>	207.60	163.22	165.22	
Average		196.05	155.15		
Total average		201.58	160.17		
LSD (p= 0.05)		Cultivars =5.01	Roselle leaf extract =6.13	Bio-fertilizer=6.13	Cultivars ×Roselle=6.23

oxidant in metabolism. The extract contains potassium important in the manufacture of proteins. The extract also contains the magnesium that stabilizes the ribosomes, which contains Rioonyc protein (Gamal 2005).

**Number of seeds per head:** The Shumus cultivar recorded significantly higher number of seeds per head (1334.43 seed per head) than in Flamy cultivar (1202.66 seed per head) (Table 5). The maximum number of seed per head was in Roselle plant extract (1284.20 seed per head), while the EM1 bio-fertilizer gave the lowest (1252.20 seed per head). The 25% of Roselle plant extract significantly excelled on than other concentrations (1481.03 seed per head). The concentration 4 ml L<sup>-1</sup> of EM1 biofertilizer gave, the highest averages of the studied trait (1451.37 seed per head) significantly higher than in other concentrations The Roselle plant extract increases the efficiency of the plant's absorption

of nutrients and increases photosynthesis because adding the solution of Roselle plant makes the medium base which increases the activity of cells and enzymes which in turn increases the activity of the biological processes of the plant (Abou-Khadrah 2002, Alik 2007).

**1000 seeds weight (g):** The significantly higher averages of 62.65 g, was observed in Shmus cultivar than in Flamy cultivar (57.98 g) (Table 6). The EM1 bio-fertilizer resulted in higher 1000 seeds weight (62.80 g) than in the Roselle plant extract ( 57.32 g). The concentration 4 ml L<sup>-1</sup> of EM1 bio-fertilizer excelled for the studied trait by giving it the highest averages of 76.30 g while the control treatment gave the lowest averages of 49.04 g. Roselle plant at 25% gave the highest averages compared to the other concentrations (68.63 g) while the control treatment gave the lowest of the averages (46.60 g). The higher seed weight in EM1 bio-

**Table 3.** Effect of Roselle leaf extract and bio-fertilizer EM1 on number of leaves in sunflower (leaf per plant)

Treatments	Concentrations	Shumus cultivar	Flamy cultivar	Average
Roselle leaf extract	0%	25	22	23.5
	15%	28	24	26
	25%	33	29	31
	35%	30	27	28.5
Average		29	25.5	
Bio-fertilizer	0 ml L <sup>-1</sup>	23	21	22
	3 ml L <sup>-1</sup>	27	23	25
	4 ml L <sup>-1</sup>	30	27	28.5
	5 ml L <sup>-1</sup>	28	25	26.5
Average		27	24	
Total average		28	24.75	
LSD (p= 0.05)	Cultivars =1.454	Roselle leaf extract =1.781	Bio-fertilizer=1.781	Cultivars ×Roselle=2.519

**Table 4.** Effect of Roselle leaf extract and bio-fertilizer EM1 on leaf area in sunflower (m)

Treatments	Concentrations	Shumus cultivar	Average	Flamy cultivar
Roselle leaf extract	0%	0.842	0.782	0.722
	15%	1.253	1.219	1.187
	25%	1.536	1.435	1.334
	35%	1.326	1.281	1.236
Average		1.239	1.179	1.119
Bio-fertilizer	0 ml L <sup>-1</sup>	0.759	0.727	0.696
	3 ml L <sup>-1</sup>	1.162	1.129	1.097
	4 ml L <sup>-1</sup>	1.416	1.371	1.326
	5 ml L <sup>-1</sup>	1.366	1.311	1.256
Average		1.207	1.134	1.106
Total average		1.207	1.156	1.106
LSD (p=0.05)	Cultivars =0.228	Roselle leaf extract =0.307	Cultivars ×Roselle=0.425	Bio-fertilizer=0.307

**Table 5.** Effect of Roselle leaf extract and bio-fertilizer EM1 on number of seeds per head in sunflower (seed per head)

Treatments	Concentrations	Shumus cultivar	Average	Flamy cultivar
Roselle leaf extract	0%	1166.14	978.99	1072.56
	15%	1324.29	1157.60	1240.95
	25%	1582.25	1379.81	1481.03
	35%	1426.32	1258.41	1342.23
Average		1380.80	1193.36	1284.19
Bio-fertilizer	0 ml L <sup>-1</sup>	1069.94	972.69	1021.32
	3 ml L <sup>-1</sup>	1281.89	1226.61	1254.25
	4 ml L <sup>-1</sup>	1482.84	1419.90	1451.37
	5 ml L <sup>-1</sup>	1317.59	1244.60	1281.09
Average		1288.06	1215.95	1252.20
Total average		1334.43	1204.66	1269.54
LSD 0.05 (p=0.05)	Cultivars =86.66	Roselle leaf extract =94.20	bio-fertilizer=94.20	Cultivars ×Roselle=105.77

**Table 6.** Effect of Roselle leaf extract and bio-fertilizer EM1 on weight of 1000 seeds in sunflower (g)

Treatments	Concentrations	Shumus cultivar	Average	Flamy cultivar
Roselle leaf extract	0%	47.29	45.92	46.60
	15%	59.44	52.86	56.15
	25%	71.98	65.27	68.63
	35%	60.24	55.59	57.92
Average		59.73	54.91	57.32
Bio-fertilizer	0 ml L <sup>-1</sup>	50.29	47.79	49.04
	3 ml L <sup>-1</sup>	63.43	59.33	61.38
	4 ml L <sup>-1</sup>	78.11	74.49	76.30
	5 ml L <sup>-1</sup>	66.40	62.61	64.51
Average		65.56	61.06	60.31
Total average		62.65	57.98	
LSD (p=0.05)	Cultivars =2.807	Roselle leaf extract =3.438	Bio-fertilizer=3.438	Cultivars ×Roselle=4.862

**Table 7.** Effect of Roselle leaf extract and bio-fertilizer EM1 on total seed yield in sunflower (tons per ha)

Treatments	Concentrations	Shumus cultivar	Average	Flamy cultivar
Roselle leaf extract	0%	2.941	2.397	2.669
	15%	4.189	3.263	3.726
	25%	6.074	4.803	5.438
	35%	4.582	3.730	4.156
Average		4.366	3.494	4.012
Bio-fertilizer	0 ml L <sup>-1</sup>	2.869	2.479	2.674
	3 ml L <sup>-1</sup>	4.336	3.881	4.108
	4 ml L <sup>-1</sup>	6.173	5.640	6.30
	5 ml L <sup>-1</sup>	4.665	4.155	4.41
Average of		4.510	4.053	4.281
Overall average		4.454	3.773	
LSD (p=0.05)	Cultivars =0.148	Roselle leaf extract =0.181	Bio-fertilizer=0.18	Cultivars ×Roselle=0.256

fertilizer can due to 60 active and beneficial microorganisms, including bacteria representing light, lactic acid bacteria, yeast types, fungi, etc. Soil, light can be used as an energy source and the use of carbon dioxide as a carbon source. The lactic acid bacteria, reduce the pH of the soil, which helps dissolve nutrients and accelerate the decomposition of substances. Complex organics inhibit the growth of pathogenic fungi, while yeasts secrete amino acids and vitamins that cause the growth of other microorganisms such as lactic acid bacteria and secreted hormones and enzymes that encourage rapid growth in plants (Abou et al 2002, Mohammed et al 2003).

**Total seed yield (tons per ha):** The Shumus cultivar significantly increased of the total seed yield trait by giving it the highest average of 4.454 tons per ha, while the Flamy cultivar gave the lowest average of 3.773 tons ha<sup>-1</sup> (Table 7). The EM1 Biofertilizer was significantly better than Roselle plant extract with the highest averages of 4.281 tons per ha. The concentration of EM1 biofertilizer at 4 ml L<sup>-1</sup> recorded significantly higher total yield, (6.30 tons per ha) while the control lowest averages of 2.674 tons per ha. The 25% Roselle plant extract gave the highest averages of 5.438 tons ha, The higher yield in EM1 bio-fertilizer can be due higher humus in the soil and secrete some chelating materials that help absorb iron and improve soil construction, accelerate growth and increase the efficiency of plant absorption of nutrients and water and thus increase production (Karim et al 2014).

## CONCLUSIONS

The genotypes Shumus genotype excelled in all the traits. Roselle leaf extract and the EM1 also excelled in most of the traits. The combination 25% Roselle leaf extract x Shumus cultivar was gave highest averages for plant height, number of leaves, leaf area, number of seeds per head followed by combination 4g L<sup>-1</sup> EM1 x Shumus cultivar.

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