Germination, Seedling Vigorosity of Sunflower Plants and Physical Properties of Soil as affected by Agrosil and Irrigation Intervals

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I. INTRODUCTION

Water use in arid and semiarid regions plays an important role from economic aspects in general and from the agricultural point of view in particular. The water supply in the Libyan Arab Republic is often insufficient or irregular. Large areas of Libya receive neither enough precipitation nor a regular supply. However, no studies have been carried out to increase the water holding capacity of Libyan soils. In many areas of the arid and semiarid regions, there is a large potential for improving the physical soil properties by applying soil conditioners. Agrosil is one of these materials, which has a colloidal alkali-hydrosilicate material with higher electric chemical field power with nitrate compounds. For the effectiveness of this material, an appropriate amount of urea and calcium-triphosphate should be added. Hurt, (5), recommended the use of Agrosil for increasing the yield of barley. On the other hand, Abdel Karim, 1969, found that the yield of corn tended to increase with Agrosil treatment but the difference failed to reach the 5% level.

The aim of this work is to study the effect of irrigation intervals and different doses of Agrosil on the germination and seedling vigorosity of sunflower plants. Due consideration was given to the effect of these factors on physical soil properties.

II. MATERIALS AND METHODS

One pot experiment was assigned to investigate the effect of irrigation intervals and Agrosil levels on the germination of sunflower seeds and on soil properties at Sidi El-Mesri Experimental Station. Pots of 15 cm diameter were filled with the local soil. The physical soil properties were as follows: 82% sand, 12% silt and 5.6% clay. The permeability was 8.0 inches/hour, the percentage of organic matter was 0.394 and the pH of saturated paste was 7.9. The aggregate size distribution was:

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amount retained by the				500	micron	sieve	3.85%
,,	,,	,,	,,	180	,,	,,	20.21%
,,	,,	,,	,,	150	,,	,,	2.11%
,,	,,	,,	,,	105	,,	,,	14.70%
,,	,,	,,	,,	63	,,	,,	44.80%
,,	,,	,,	,,	53	,,	,,	8.80%
amount less than				53	,,	,,	5.50%

Twelve treatments which were the combinations of four levels of Agrosil and three irrigation intervals were distributed in a completely randomized block system in six replications. The appropriate amount of urea and calcium super-phosphate was added to the levels of Agrosil and thoroughly mixed with the soil. The levels of factors studied were as follows:

A. Agrosil levels in grams/square meter.

No. of treatments	*Agrosil*	*Urea*	*Calcium super-phosphate*
1	00	00	00
2	60	20	120
3	120	40	240
4	180	60	360

B. Irrigation intervals.

Every 3 days by 150 m^3/ha
,, 6 ,, ,, ,, ,,
,, 9 ,, ,, ,, ,,

Eight seeds of sunflower plant, variety 'Imported 13', were planted in every pot. Irrigation took place at the proper dates. Germination percentage, germination rate according to the Bartlett formula (3), germination capacity and seedling vigorosity were recorded. Soil samples from two replicates were subjected to physical and mechanical analysis at the end of the experiment.

III. RESULTS AND DISCUSSION

Data reported in Table (1) indicate clearly that germination percentage and germination rate increased considerably and consistently with increasing Agrosil up to the third level, i.e. 120 gm/m^2, while further increase resulted in a slight reduction. Agrosil had no statistical effect on germination capacity. The germination percentages were 58.3, 62.9, 79.6 and 72.3, whereas the germination rates were 0.78, 0.80, 0.98 and 0.85 for 00, 60, 120 and 180 gm Agrosil/m^2, respectively. The increase in germination percentage and germination rate might be due to the effect of Agrosil. Agrosil seems to increase the water holding capacity of the soil; thus the available water required for germination increased. It could be mentioned that the function of Agrosil was similar to that of humus or manure in big quantities. On light sandy soil without active organic matter, like that of this experiment, Agrosil, it seems, is capable of narrowing the big pores between sandy particles, so that the water capacity could be raised several times above original quantity. On the other hand, the reduction in germination percentage and germination rate at the high level of Agrosil, i.e. 180 g/m^2 might be due to the increase in the free energy of the soil solution. Consequently, a relative difficulty in water uptake.

Table 2 Effect of Agrosil dose on soil properties at the end of the experiment

Treatment No.	moisture %	pH	permeability ir/hr.	organic matter %	Mechanical analysis			Aggregation (% retained by sieve)						
					sand %	silt %	clay %	500 μ	180 μ	150 μ	105 μ	63 μ	53 μ	53 μ
(1)	1.42	7.90	8.00	0.428	78.4	13.8	7.8	3.5	16.7	1.63	20.6	51.1	1.6	0.93
(2)	1.89	7.52	6.45	0.460	77.4	15.4	7.2	3.6	18.2	1.83	25.9	44.8	1.9	1.13
(3)	2.31	7.46	6.92	0.679	79.4	13.4	7.2	3.5	18.3	2.0	24.9	48.1	1.9	1.43
(4)	3.06	7.40	6.66	0.629	80.8	11.0	8.2	3.8	20.6	2.03	18.5	52.5	2.2	1.11

Table 1 Effect of Agrosil doses on germination and seedling vigorosity of sunflower plants.

Treatment No.	Germination			Seedling vigorosity		
	percentage	capacity	rate	average dray weight of 5 seedlings gm	seedling length cm	Dry weight percentage
1	58.3	90.7	0.78	0.707	6.4	13.3
2	62.9	92.5	0.80	1.195	9.1	16.6
3	79.6	88.8	0.93	1.056	9.5	13.4
4	72.3	90.6	0.85	0.789	8.8	13.2
L.S.D. at 5%	13.4	N.S.	0.08	0.136	1.3	—

Germination capacity was not affected by the Agrosil level as it refers to germinability of seeds regardless of the time required for germination.

The change in seedling vigorosity with change in Agrosil level followed the same pattern of change as those of germination percentage and germination rate. Data reported in Table 1 indicate clearly that the average dry weight of five seedlings and plant height increased consistently and considerably with increasing Agrosil level up to 120 g/m^2. The average dry weight of five seedlings was 0.700, 1.195, 1.056 and 0.789 gm for 00, 60, 120 and 180 gm Agrosil/m^2, respectively. The average seedling height was 6.4, 9.1, 9.4 and 8.8 cm for the same respective levels of Agrosil. The increase in the dry matter content of sunflower seedlings with Agrosil might be due to the increase in germination rate and/or the more favourable conditions for growth attained for the sunflower. Moreover, the colloidal alkali-hydrosilicate system of Agrosil increased the water holding capacity and diminished the rate of nutrients washed down, especially nitrogen and potash. Therefore, plants could overcome the dry periods. In addition, the stimulative effect on the germination rate may be attributed to a greater and earlier dry matter accumulation.

Increasing the dose of Agrosil up to 180 g/m^2 resulted in a reduction in the dry matter content and plant height. Besides, a rootless wetted layer was observed 8 cm from the upper surface. The reduction in the dry matter content and plant height might be due to the inability of plant roots to penetrate downward into the wetted layer. This may be attributed to a deficiency of oxygen in the wetted layer caused by Agrosil.

The dry matter percentage in the tissues of seedlings increased by adding Agrosil at 60 g/m^2; then it suffered no change as shown in Table 1.

B. Effect on Soil Properties

Data reported in Table 2 indicate clearly that the moisture percentage in the soil increased remarkably and consistently by adding Agrosil. The soil moisture percentage of soil treated by 180 gm. Agrosil/m^2 was 2.1 times as much as that untreated. Agrosil decreased the permeability of soil from 8.00 inches/hour to 6.66 inches/hour. In this respect one can say, that Agrosil application to light soil is characterized by throating the pore spaces, by high increase of water capacity and amelioration of water dynamics.

The organic matter percentage of soil treated with Agrosil was greater than that

untreated as shown in Table 2. Adding Agrosil stimulated the growth of root system which resulted in an increase of organic matter in the soil.

Agrosil decreased the pH value as shown in Table 2. The reduction in pH value might be due mainly to the acidic effect of calcium superphosphate that was added to the soil and/or to the increase in the organic matter content of the soil.

The mechanical analysis showed no change. This is quite expected as mechanical analysis refers to the ratio of sand, silt and clay in the soil. None of these variables was changed.

Agrosil seems to increase the percentage of big aggregates. The aggregates attained on sieves of 500, 180, 150, 53 and less than 53 microns for soil treated with 180 gm. Agrosil/m^2 were 1.08, 1.21, 1.20, 1.39 and 1.17 times as much as those for untreated soils, respectively.

II. EFFECT OF IRRIGATION INTERVALS

A. Effect on germination and seedling vigorosity

Data reported in Table 3 indicate clearly that irrigation intervals had no significant effect on the germination percentage of sunflower seeds. This was the same on the germination capacity and germination rate. This means that seeds irrigated every 3, 6 or 9 days have the same capacity to germinate though the germination rate tended to increase by shortening the interval of irrigation from 9 to 3 days.

On the other hand, seedling vigorosity significantly increased by shortening the irrigation interval, i.e. irrigation every 3 days as shown in Table 3. The average dry weight of five seedlings was 1.303, 0.985 and 0.693 gm for seedlings irrigated every 3, 6 and 9 days, respectively. The average plant height followed the same trend; it was 10.9, 8.4 and 6.1 cm for the same respective irrigation intervals. The dry weight of seedling and plant height of plants irrigated every 3 days were increased 1.80 and 1.78 times as much as those irrigated every 9 days, respectively. The increase in seedling vigorosity by lengthening irrigation intervals is quite expected as water plays a predominant role in growth. Hunt (5), Baker and Musgrave (2) and Wright (6) are of the opinion that water stresses reduce growth, photosynthesis and yield of crops.

The dry matter percentage of seedlings increased remarkably by lengthening irrigation intervals as shown in Table 3. The dry matter percentage of seedlings irrigated every 9 days was 1.35 times as much as those of 3 day intervals.

Table 3 Effect of irrigation intervals on germination and seedling vigorosity of sunflower plants

	Germination			Seedling vigorosity		%
Irrigation intervals days	percentage	capacity	rate	average dry weight of 5 seedlings gm	seedling length cm	of dry weight
3	68.3	93.7	0.87	1.303	10.9	12.9
6	70.8	90.9	0.83	0.985	8.4	12.8
9	65.1	87.4	0.82	0.693	6.1	17.1
L.S.D. at 5%	N.S.	N.S.	N.S.	0.118	1.10	—

B. Effect of Agrosil Level X Irrigation Interval Interaction on Germination and Seedling Vigorosity:

The significant effect of Agrosil levels X irrigation intervals, showed that the greatest germination percentage of sunflower seeds was obtained by irrigation every 3 days and at 120 gm Agrosil/m^2. On the other hand, no significant interaction was noticed regarding germination rate, germination capacity, dry weight of seedling or plant height. Therefore, data were not included.

C. Effect on Soil Properties:

The irrigation intervals exerted no considerable effect on soil properties as shown in Table 4. Nevertheless, it is noteworthy to mention that soil moisture percentage decreased by lengthening the irrigation interval. On the other hand, organic matter percentage increased with more frequent irrigation.

SUMMARY

The effect of irrigation intervals and Agrosil (a soil conditioning material) on germination, seedling vigorosity of sunflower plants and soil properties was studied. The results can be summarized as follows:

1 Germination percentage and germination rate of sunflower seeds increased by adding Agrosil up to 120 g/m^2, then declined. On the other hand, germination capacity was not affected by Agrosil treatment.

Seedling vigorosity, i.e. dry weight and height, followed the same trend of change as that of germination percentage. They increased when applying up to 120 gm Agrosil/m^2 then decreased.

2. Soil moisture percentage and organic matter percentage increased remarkably by adding Agrosil. On the other hand, pH value and permeability decreased.

Agrosil tended to increase the percentage of big aggregates in the soil but it had no effect on the mechanical analysis of the soil.

3. Germination was not statistically affected by irrigation intervals, while seedling vigorosity increased by shortening irrigation intervals, i.e. irrigation every three days.

4. Irrigation intervals had no considerable effect on soil properties, i.e. soil mechanical analysis, aggregation permeability and organic matter content. On the other hand, soil moisture percentage decreased and organic matter increased with increasing intervals between irrigation.

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Table 4 Effect of irrigation intervals on soil properties at the end of experiment

Irrigation intervals Days	moisture %	pH	permeability ir/hr.	organic matter %	Mechanical analysis			Aggregation (% retained by sieve)						
					sand %	silt %	clay %	500 μ	180 μ	150 μ	105 μ	63 μ	53 μ	53 μ
3	2.54	7.50	6.04	0.499	78.2	14.4	6.8	3.8	25.9	1.82	26.8	45.2	1.75	1.0
6	2.12	7.57	8.13	0.617	81.4	11.4	7.2	3.7	25.8	1.85	18.3	58.4	2.1	1.5
9	1.84	7.60	6.33	0.724	81.4	11.8	6.8	3.6	25.6	1.95	23.3	48.4	1.9	1.2

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