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Autecology of *Kochia indica* Wight

A.M. El-Habibi*, M.M. Youssef and M.E.A. Abu-Ziada***

* *Faculty of Science, Mansoura University, Mansoura, Egypt.*

** *Faculty of Girls, Al-Azhar University, Cairo, Egypt.*

Autecological studies on *Kochia indica* were made including macromorphology, soil vegetation analysis and characteristics of supporting soil. The soil supporting *Kochia indica* in the three selected localities was sandy, calcareous and alluvial having different values of porosity, water-holding capacity, moisture content, calcium carbonate content, organic carbon, total soluble salts, chlorides, sulphates, bicarbonates and pH.

Vegetation analysis in these localities showed that *Kochia indica* the dominant species had the highest cover and density. The floristic composition revealed that most of the associated species were canal bank weeds. The effects of salinity, rainfall, light and darkness and depth of sowing on seed germination were studied. The growth of *Kochia indica* was also studied in relation to salinity tolerance.

The genus *Kochia* is represented in the Egyptian flora by a single species, *Kochia indica* Wight. It is an annual richly branched chenopodiaceous herb. Under favourable conditions the plant may reach a hight of 2m. It is more or less densely hairy. Leaves carried on sterile branches are linear - lanceolate, 3–4cm long, but on flowering branches are very narrow, only a few mm long (Täckholm 1974).

The plant is widely distributed in our deserts. It is recorded in the Nile Delta, Oasis, Libyan desert and Mediterranean coastal strip from El-Sallum to Rafah (Täckholm 1974). El-Habibi *et al.* (1976) recorded it in Kharaga oasis at Ain Dekhakhin and Ain Bargas.

Several studies were made by various workers on *K. indica* and the utilization of its vegetative growth as a green fodder for cattle, sheep..etc. and as a source of rayon or celluphane (Drar 1952; Foury 1952; El-Shishiny 1953; El-Shishiny & Thoday 1953; Thoday 1956; Thoday *et al.* 1956; Negbi & Evenari 1959; Salem 1960; and Sadek 1974).

The plant contains many active constituents of medicinal valuė as alkaloids, saponins,

glycosides and flavonoids (Borkowski & Drost 1965, Coxworth & Salmon 1972; Golovchenko & Makhamadzhorov 1972 and Kernan *et al.* 1973).

The present work is an attempt to throw further light on the autecology of *Kochia indica*, including macromorphologly, and characteristics of the supporting soil. Natural vegetation dominated by *Kochia indica* was also analysed. Germination of *Kochia indica* seeds under different levels of salinity, rainfall, depth of sowing and light were studied. The growth of seedlings under different salinity levels was also investigated.

Results and Discussion

Macromorphology

Kochia indica has a principal tap root which carries many secondary roots. The stem is cylindrical, solid, erect, hairy and richly branched (monopodial branching). The leaves of the vegetative branches are exstipulate, cauline, alternate and sessile. The blade is simple, liner-lanceolate, 2–3cm long, with entire margin, acute apex, reticulate venation and its surface is floccose. The flower is small, regular, bisexual, with 5 toothed perianth. Stamens are five opposite to the perianth leaves. The ovary is superior and composed of two united carpels, containing one ovule on basal placenta. The fruit is a nut with a winged perianth. The seed is oval in shape, black in colour small in size and very bouyant.

Kochia indica seeds begin to germinate during the second half of February and the plant attains its maximum vegetative growth during June and July. On the first week of August, the plant blossoms. The fruiting stage starts at the end of August and the begining of September. Dryness of the plant, symptoms of the end of its life cycle, begins during October.

It is worth to mention that the colour of the plant changes during the successive stages of its life cycle, being deep green during the vegetative growth stage, till the begining of the fruiting stage. The plant attained a reddish colour during the dry condition.

Soil analysis

The data presented in Tables (1 & 2) showed that the soil supporting *Kochia indica* in Alexandria district was sandy in texture. The percentages of the fine components (silt and clay) were much lower than those of the coarser components (sand and fine sand, the latter being as much as 88% of the total weight of the soil, as it is clear from Table 1). In case of soil samples collected from Mansoura district (mostly alluvial soil built by the Nile sediments), though the sandy fraction was also high yet, the silty and clay fractions were present in relatively higher percentages (Table 2).

Porosity did not vary widely in calcareous soils, ranging between 30.00% and 58.90%, but in alluvial soils there was a wider range of variation.

Table 1. Data of physical and chemical analyses of soil samples supporting *Kochia indica* growing in Alexandria district (April, 1976).

	Localities	Profile No.	Sample No.	Depth (cm)	Physical characteristics									Chemical characteristics						
					% of soil fractions							Mean porosity	Mean W.H.C.	$CaCO_3$	organic carbon	analysis of 1:5 water extract				
					>2.057 mm	2.057–1.003	1.003–0.5	0.5–0.211	0.211–0.104	0.104–0.053	<0.053 mm					T.S.S.	Cl	SO_4	CO_3	HCO_3	pH
												%		%		%	%	%	%	%	
Alexandria district	1km South of Alex.	A	1	0–5	0.000	1.213	8.840	41.200	39.030	6.900	2.811			89.5	0.7	1.115	0.059	0.234	0	0.060	8.00
			2	5–25	0.000	2.330	8.350	45.990	35.000	5.590	2.665	45.40	32.45	89.5	0.8	1.209	0.056	0.408	0	0.075	8.11
	11km South of Alex.	B	3	0–5	0.000	1.780	13.630	45.020	26.130	8.353	5.280			69.0	2.1	1.083	0.157	0.551	0	0.060	7.18
			4	5–25	0.000	1.910	14.080	48.550	23.530	9.530	2.310	43.16	56.50	70.5	1.1	1.461	0.073	0.447	0	0.060	7.35
	12km South of Alex.	C	5	0–5	0.000	0.000	6.960	37.960	48.270	4.120	1.690			17.0	1.0	0.807	0.095	0.703	0	0.045	7.62
			6	5–25	1.600	8.600	26.390	32.100	17.710	10.420	3.160	51.60	52.90	21.0	1.6	2.375	0.175	1.326	0	0.060	7.73

Table 2. Data of physical and chemical analyses of soil samples supporting *Kochia indica* inhabiting Mansoura district and Mansoura-Damietta road (June, 1976).

Localities		Profile No.	Sample No.	Depth (cm)	Physical characteristics					Chemical characteristics							
					% of soil fractions			Mean porosity %	Mean W.H.C.	$CaCO_3$ %	organic carbon %	analysis of 1:5 water extract					
					Sand	Silt	Clay					T.S.S. %	Cl %	SO_4 %	CO_3 %	HCO_3 %	pH
Mansoura - Damietta road	Bilqas	D	7	0–5	63.00	30.40	6.50			10.0	2.3	1.312	0.213	1.296	0	0.090	8.12
			8	5–25	40.20	33.75	26.00	43.9	74.2	9.5	1.1	0.583	0.050	0.673	0	0.090	8.22
	Kafr-Sa'd	E	9	0–5	41.75	53.50	4.60			10.5	1.0	2.027	0.877	0.314	0	0.081	7.95
			10	5–25	32.00	63.25	4.50	33.8	62.9	10.5	0.3	0.865	0.455	0.360	0	0.075	8.20
	Basandila, 10km from Bilqas	F	11	0–5	49.20	46.00	4.75			7.5	0.4	0.476	0.250	0.376	0	0.061	7.54
			12	5–25	47.80	41.60	10.20	30.0	60.3	7.5	0.5	0.342	0.120	0.158	0	0.075	8.49
	El-Sawalim, 23km from Damietta	G	13	0–25	28.00	67.00	4.80	35.1	71.6	11.5	1.5	4.437	1.300	0.783	0	0.060	8.10
Mansoura district ($^1/_2$km east of the Fac. of Agric.)	quadrat a	H	14	0–5	54.00	40.60	4.45			11.0	1.1	2.60	1.005	0.726	0	0.045	7.67
			15	5–25	41.80	48.00	10.00	54.8	57.6	5.5	0.8	0.20	0.085	0.142	0	0.090	8.55
	quadrat b	I	16	0–5	53.00	41.50	5.40			9.5	0.6	3.09	0.980	0.879	0	0.036	7.74
			17	5–25	36.00	60.00	3.70	58.9	53.8	10.5	0.6	0.55	0.220	0.379	0	0.060	8.15
	quadrat c	J	18	0–5	46.00	46.00	7.90			11.5	0.8	2.95	0.750	0.475	0	0.060	7.84
			19	5–25	40.25	55.25	4.40	48.9	60.5	4.0	0.7	1.17	0.237	0.622	0	0.060	8.20
	quadrat d	K	20	0–5	44.00	51.30	4.50			11.5	1.0	1.67	0.685	0.198	0	0.045	7.85
			21	5–25	42.80	52.00	5.00	45.8	57.3	6.0	0.8	0.86	0.235	0.224	0	0.060	8.20
	quadrat e	L	22	0–5	61.00	28.90	10.00			7.0	1.4	7.46	4.440	1.134	0	0.036	7.27
			23	5–25	59.20	36.00	4.60	35.2	58.4	11.0	1.1	2.68	0.610	0.445	0	0.045	7.90

The water holding capacity was higher in the alluvial soil of Mansoura district. *Kochia indica* seems to flourish only in soil with high moisture content.

Calcium carbonate content was higher in the soil samples collected from Alexandria district (89.5%) than in those of Mansoura district (11.5%).

Organic carbon content was generally higher in the surface layers (0.4% – 2.3%) than in the subsurface ones (0.3% – 1.6%), with few exceptions.

Generally speaking the soils supporting *Kochia indica* were relatively saline. In most profiles located in Mansoura district, the surface layers were of relatively higher salt content than the subsurface ones, and the reverse was true in the profiles of Alexandria district. The highest value of total soluble salts recorded was 7.46% (sample 22).

Chlorides and sulphates were the major constituents of the soluble salts while soluble carbonates were absent and bicarbonates were present in low concentrations (ranging between 0.036 and 0.90%). Soil reaction was generally alkaline.

Vegetation analysis

The vegetation dominated by *Kochia indica* was studied qualitatively and quantitatively using the quadrat method described by Hanson and Churchill (1965).

It is evident from Table 3 that *Kochia indica* covered the greatest part of the stand (total area 105.2 m^2, frequency 100%). Five species namely, *Conyza linifolia, Polypogon monospeliensis, Typha domingensis, Cynodon dactylon* and *Cyperus rotundus* were recorded in the five quadrats (Fr. = 100%) but their total cover varied greatly between 72.493 m^2 in case of *Cynodon dactylon* and 0.056 m^2 for *Phoenix dactylifera*. Other species recorded in the stand were: *Conyza aegyptiaca* (Fr. = 80%), *Polygonum salicifolium* (Fr. = 60%), *Emex spinosus* (Fr. = 60%),*Convolvulus arvensis* (Fr. = 20%), *Chenopodium murale* (Fr. = 20%), and *Phoenix dactylifera* (Fr. = 20%) (Cover = 0.0567 – 1.6180 m^2).

Kochia indica had the highest total area (105.2 m^2) and total number of individuals (994) in five quadrats, followed by *Conyza linifolia* while *Convolvulus arvensis* and *Phoenix dactylifera* had the lowest values as shown in Table 3.

The floristic composition of this stand shows that most of the associated species of *Kochia indica* community were canal bank weeds and reed swamp plants.

Germination

Sadek (1974), made two experiments to investigate the effect of temperature and salinity on the germination of *Kochia indica* seeds. She found that germination was enhanced by raising the temperature up to 35°C but was lowered greatly by the increased NaCl concentration. Germination was inhibited completely when the seeds were treated with 2% NaCl solution.

In the present study more germination experiments were conducted to find out the effect of salinity, rainfall, light and depth of sowing on the rate of germination of *Kochia indica* seeds. Viability of seeds was also tested after 9 months of fruit collection.

Table 3. **Analysis of five quadrats (10 x 10 m each) set up in a *Kochia indica* stand in a waste land of Mansoura district.**
No. = number of individuals in each quadrat.
TA. = total area of the individuals in each quadrat (m^2).
Fr. = frequency (%).

Date 8 / 7 / 1976.

Quadrats / Species	a		b		c		d		e		Total number	Total Area (m^2)	Fr. %
	No.	Area (m^2)	No.	Area (m^2)	No.	Area (m^2)	No.	Area (m^2)	No.	Area (m^2)			
Kochia indica	196	9.700	199	30.000	193	21.750	219	13.000	187	30.750	994	105.200	100
Conyza linifolia	189	15.950	127	10.720	170	14.350	210	17.720	163	13.750	859	72.490	100
Polypogon monospeliensis	59	3.980	95	6.400	180	12.130	195	13.140	95	6.420	624	42.080	100
Cyperus rotundus	292	7.970	70	1.510	35	0.750	24	0.500	21	0.450	342	7.380	100
Typha domingensis	235	2.925	16	0.160	148	1.480	103	1.030	22	0.220	524	5.810	100
Cynodon dactylon	23	0.200	115	1.020	16	0.140	164	1.870	16	0.143	334	3.005	100
Polygonum salicifolium	—	—	45	0.390	36	0.310	103	0.910	—	—	184	1.618	60
Conyza aegyptiaca	—	—	7	0.163	3	0.070	1	0.023	7	0.164	18	0.421	80
Emex spinosus	—	—	—	—	2	0.024	6	0.070	6	0.074	14	0.168	60
Convolvulus arvensis	—	—	—	—	2	0.166	—	—	—	—	2	0.166	20
Chenopodium murale	—	—	—	—	—	—	—	—	19	0.091	19	0.091	20
Phoenix dactylifera	1	0.056	—	—	—	—	—	—	—	—	1	0.056	20

1. *Effect of salinity*

Seeds of *Kochia indica* were germinated in Petri-dishes lined with wet filter paper. Replicates of eight concentrations of NaCl solutions, namely, 0.02, 0.03, 0.04, 0.1, 0.2, 0.3, 0.4 and 0.5 M were used. Fifty seeds were sown in each Petri-dish. Control Petri-dishes were irrigated with distilled water instead of the saline solutions. Germination was carried out under laboratory conditions of mean temperature 22°C.

It is evident from Fig. 1 that the percentage of germination of *Kochia indica* seeds was highest (100%) when the seeds were treated with distilled water, 0.02, 0.03 and 0.04 M NaCl solutions. At 0.1, 0.2 and 0.3 M NaCl solutions, germination percentages were reduced to 90, 74 and 54% respectively. But the percentage of germinating seeds treated with 0.4 and 0.5 M NaCl was decreased to a value of 34 and 12%, respectively.

These results show that the percentage germination decreased with increasing salinity and the minimum rate of germination was at 0.5 M NaCl (3%).

2. *Effect of rainfall*

Germination was conducted in glazed pots of equal size (15x20cm) filled with sandy soil. Replicates of six amounts of irrigation water equivalent to 5, 10, 15, 20, 25 and 30 mm rainfall were used. The amount of water added was calculated according to the area of soil surface in the pots. The effect of excessive soil water content on the seed germination of *Kochia indica* was also tested in another set of pots filled with highly saturated sand.

It is evident from Fig. 1 that the germination of seeds failed when irrigated with water equivalent to 5 and 10 mm rainfall. The increase in the amount of water was associated with successive increase in the percentage of germinating seeds, being 42, 52, 62 and 74% at 15, 20, 25 and 30 mm rainfall respectively. In the highly moistured soil germination was up to 98%.

It is clear that *Kochia indica* needs a lot of water in the soil to germinate well and this may explain its flourishing and dense growth on or near the canal banks.

3. *Effect of light and darkness*

Light sensitivity of the seeds of *Kochia indica* was studied as follows;

a) Continuous white light supplied by a Neon lamp, 360 Lux.

b) Continuous darkness except for about two minutes every day during the counting of germinating seeds.

c) Alternating light and darkness of day and night.

Figure 1 shows that the lowest percentage of germinated seeds of *Kochia indica* was recorded in the Petri-dishes subjected to continuous Neon light being 36%, while highest percentages of germinations were recorded for the seeds present in continuous darkness and alternating darkness and light being 86 and 94%, respectively. The germination of *Kochia indica* seeds seems to be enhanced by the alternating day and night.

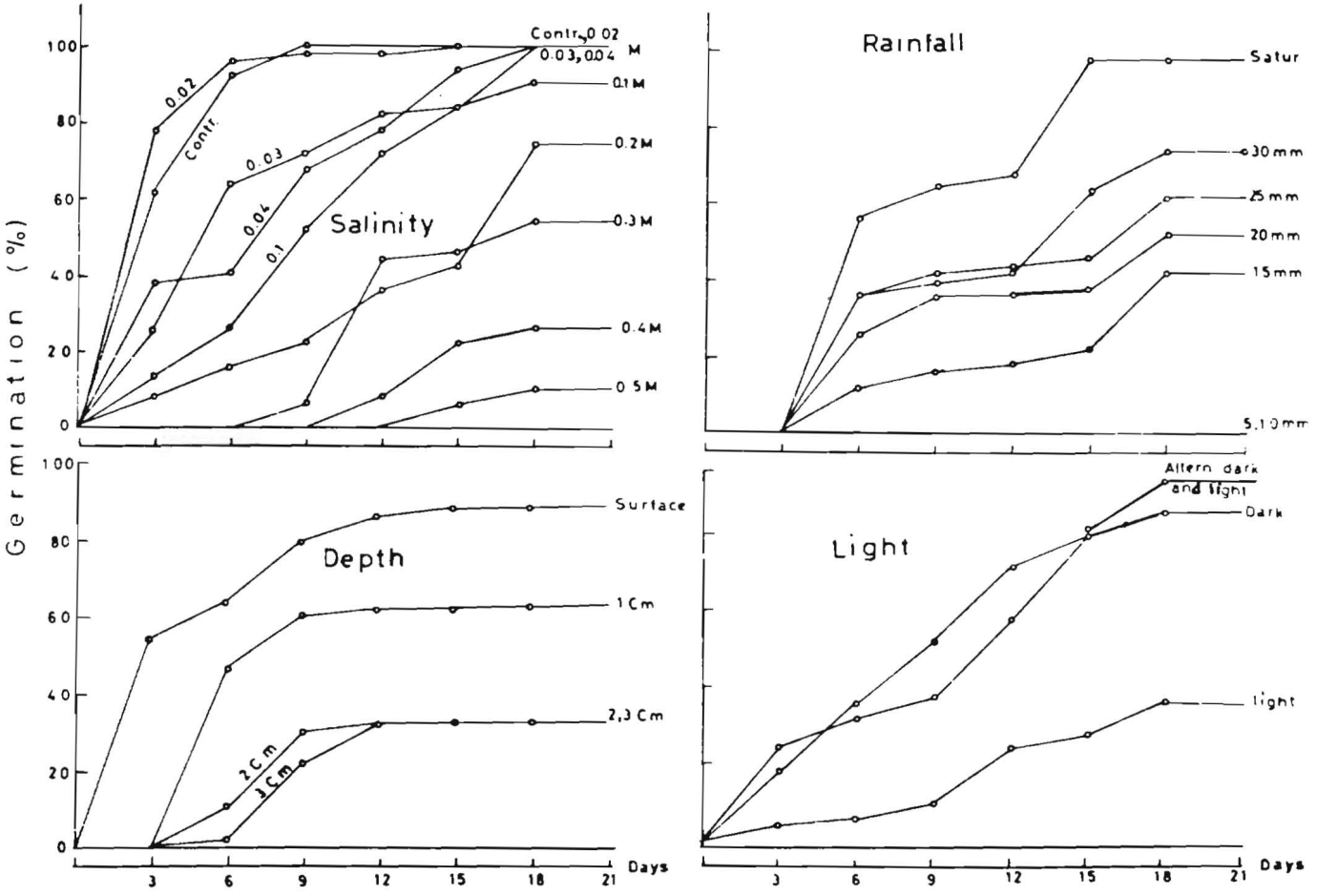

Fig. 1. Germination of *Kochia indica* seeds under different levels of salinity, rainfall, depth of sowing and light.

4. *Effect of depth of sowing*

The seeds were sown at depths of 0, 1, 2 and 3 cm and the pots were irrigated with water to keep the soil nearly around the field capacity. Emergent seedlings were daily counted and recorded.

Figure 1 elucidates that the percentage of seedling emergence of *Kochia indica* was highest in the case of seeds sown at the surface, being 88; but at 1 cm depth it was 62%, then decreased to 32% at 2 and 3 cm depth.

5. *Viability of seeds*

Naked seeds of *Kochia indica* lost their viability under natural conditions within six months after harvesting. Trials to germinate seeds usually were unsuccessful until one year after their harvesting (Sadek 1974).

In the present work, germination experiments were carried out to test the ability of *Kochia indica* seeds harvested in November 1976 to germinate after 9 months *i.e.*, August 1977.

The tested seeds were of two types:

a) Type 'A' seeds: in which pericarps of the fruits were removed directly after their collection and the seeds kept naked.
b) Type 'B' seeds: which were kept enclosed in the pericarps of the fruits till the begining of the experiment.

Duplicate Petri-dishes with wet filter paper were used in each case. Fifty seeds were sown in each dish. The experiment was started on August, 20, 1977 and continued for one week.

The seeds of type 'A' failed to germinate, while seeds of type 'B' attained 100% germination after 3 days of sowing.

This may indicate that the pericarps protected the seeds against unfavourable conditions which had harmful effects on the naked seeds that hindered their germination.

6. *Salinity tolerence*

Eighty equal-sized seedlings of *Kochia indica* were transplanted in 16 small pots (5 seedlings in each pot) half of which were filled with sand and the remainder with silty soil supporting *Kochia indica* at Mansoura district. All the pots were irrigated with tap water once every 72 hr for 6 weeks till the plants attained their normal growth conditions. Then the pots of sandy soil were divided into four sets (each set of 2 pots). In the first set, the pots were irrigated with 0.5,2 and 3% sodium chloride solution respectively. The same procedure was repeated for the pots containing silty soil. Application of NaCl solutions was carried out only once then the plants were irrigated with tap water at regular intervals in a way to keep the soil at its field capacity. The experiment continued for about 2 months. The plants were harvested and lenghts of their shoot systems as well as fresh and dry weights were determined.

Table 4. Results of salinity tolerance experiment of *Kochia indica*
Date of the begining of the experiment: 26 / 5 / 1977
Date of harvesting: 26 / 7 / 1977

Treatment	Soil type	pot No.	Height					
			1	2	3	4	5	Mean
dist. H_2O (control)	Silty soil	1	15.0	19.0	20.5	14.5	15.0	16.8
		2	22.0	21.5	29.0	20.0	21.0	22.7
		Mean	18.5	20.2	24.7	17.2	18.0	19.7
	Sandy soil	1	10.5	9.0	9.5	6.5	—	8.8
		2	9.0	8.5	8.0	7.0	8.5	8.2
		Mean	9.7	8.7	8.7	6.7	8.5	8.5
3% NaCl solution	Silty soil	1	17.0	23.5	14.0	20.0	17.5	18.4
		2	13.0	15.0	14.0	15.5	12.5	14.0
		Mean	15.0	19.2	14.0	17.7	15.0	16.2
	Sandy soil	1	9.5	7.5	7.7	8.0	9.5	8.4
		2	—	—	—	—	—	—
		Mean	9.5	7.5	7.7	8.0	9.5	8.4
2% NaCl solution	Silty soil	1	24.0	23.8	28.4	22.5	24.4	24.6
		2	10.5	8.0	10.0	9.5	10.5	9.7
		Mean	17.2	15.9	19.2	16.0	17.4	17.1
	Sandy soil	1	15.0	11.5	8.5	10.0	10.0	11.0
		2	15.0	14.0	11.5	7.2	9.5	11.4
		Mean	15.0	12.7	10.0	8.6	9.7	11.2
0.5% NaCl solution	Silty soil	1	14.0	14.5	19.0	19.5	22.0	17.8
		2	15.0	16.0	14.0	17.0	13.0	15.0
		Mean	14.5	15.2	16.5	18.2	17.5	16.4
	Sandy soil	1	11.5	12.5	13.5	14.0	10.0	12.2
		2	21.5	17.0	17.5	—	—	18.6
		Mean	16.2	14.7	15.5	14.0	10.0	15.4

Fresh weight						Dry weight					
1	2	3	4	5	Mean	1	2	3	4	5	Mean
2.16	2.92	3.57	1.95	2.59	2.64	0.67	0.80	0.99	0.52	0.70	0.74
2.69	2.41	4.73	2.79	3.53	3.23	0.79	0.69	1.37	0.75	1.03	0.93
2.40	2.66	4.15	2.37	3.06	2.93	0.73	0.74	1.18	0.63	0.86	0.83
0.98	0.66	0.93	0.35	—	0.73	0.29	0.17	0.29	0.11	—	0.22
0.55	0.64	0.40	0.29	1.09	0.59	0.15	0.18	0.12	0.09	0.30	0.17
0.76	0.65	0.66	0.32	1.09	0.69	0.22	0.17	0.20	0.10	0.30	0.20
3.50	5.68	3.39	6.52	4.09	4.63	0.73	1.29	0.71	1.44	0.94	1.02
1.96	2.90	2.70	4.02	1.94	2.70	0.39	0.66	0.57	0.84	0.40	0.57
2.73	4.29	3.05	5.30	3.02	3.67	0.96	0.97	0.84	1.14	0.87	0.99
1.20	1.16	0.90	1.05	1.40	1.14	0.26	0.25	0.19	0.22	0.29	0.24
—	—	—	—	—	—	—	—	—	—	—	—
1.20	1.16	0.90	1.05	1.40	1.14	0.26	0.25	0.19	0.22	0.29	0.24
4.06	2.67	4.72	3.74	3.05	3.65	0.99	0.69	1.24	0.92	0.79	0.93
2.77	1.53	2.26	1.53	2.16	2.05	0.53	0.29	0.43	0.31	0.42	0.39
3.40	2.10	3.49	2.63	2.60	2.84	0.76	0.49	0.83	0.61	0.60	0.66
3.85	1.76	1.30	1.19	2.48	2.10	0.60	0.46	0.29	0.21	0.57	0.43
3.35	2.99	1.42	0.62	1.40	1.95	0.78	0.70	0.30	0.13	0.30	0.44
3.60	2.37	1.36	0.90	3.88	2.42	0.69	0.58	0.29	0.17	0.43	0.43
1.61	2.32	2.69	3.16	3.68	2.69	0.36	0.53	0.61	0.71	0.88	0.62
3.83	2.71	2.50	3.74	1.65	2.88	0.95	0.71	0.63	1.00	0.43	0.56
2.92	2.80	2.59	3.45	2.88	2.98	0.85	0.82	0.82	0.88	0.85	0.88
0.99	1.35	1.29	1.46	1.25	1.27	0.28	0.36	0.34	0.37	0.35	0.34
2.06	1.59	1.49	—	—	1.71	0.59	0.42	0.44	—	—	0.29
1.52	1.47	1.39	1.46	1.25	1.42	0.43	0.36	0.39	0.37	0.35	0.38

It is clear from Table 4 that the silty soil seemed to be more favourable for the growth of *Kochia indica* than the sandy soil under all levels of salinity. The seedlings succeeded to grow well even when treated with 3% sodium chloride solution. The highest values of fresh and dry weights (3.67 g and 0.99 g/plant) were recorded in the pots containing silty soil and treated with 3% NaCl solution.

The height of the plants was not an indicator of its fresh and dry weights. Dwarf individuals gave higher values of fresh and dry weights than the more vigorous ones. This is due to the extensive branching of the former individuals as compared with the latter, specially in the pots of silty soil. Increasing of sodium chloride concentration was associated with increase of fresh and dry weights of *Kochia indica* plants in the silty soil, while in sandy soil the maximum fresh and dry weights were obtained in the pots treated with 2% NaCl solution.

These results may explain the dense growth of *Kochia indica* in the saline silty areas of canal banks and waste lands.

Conclusion

Kochia indica is a therophyte that has a growing season extending from February till August.

The plant was deep green during the vegetative growth stage, then changed to whitish-green during the flowering stage, till the begining of fruiting stage. It then attained a reddish colour during the drying condition.

Generally, *Kochia indica* seems to flourish in soils with relatively high moisture content. Variable values of porosity and water-holding capacity were obtained in calcareous, alluvial and saline soil samples. Soil reaction was weakly alkaline, pH 7.08–8.00, to alkaline, pH 8.00–8.55, in all the studied samples.

Vegetation analysis showed that *Kochia indica* formed a community type in the waste lands of Mansoura district.

The percentage of seed germination of the plant decreased with elevation of salinity level and increased with rise of rainfall. The maximum percentage germination was observed in case of seeds subjected to alternating darkness and lights periods, whereas continuous light gave low percentage germination. The maximum percentage germination was recorded in case of seeds sown on the soil surface. The seeds retaining the pericarps succeeded to germinate after 9 months while the naked seeds failed to do so.

Growth experiments including salinity tolerance showed that *Kochia indica* flourished more in silty soil than on sandy soil. Relatively higher values of fresh and dry weights were obtained with the plants transplanted in silty soil and irrigated with 3% NaCl solution, whereas lower values were recorded in case of sandy soil.

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دراسات بيئية ذاتية على نبات الكوخيا انديكا

أحمد محمد الحبيبي* ، محمد محمد يوسف محمد و محمد السيد علي أبو زيادة***

* قسم النبات ، كلية العلوم ، جامعة المنصورة ، مصر .

** قسم النبات ، كلية البنات الإسلامية ، جامعة الأزهر ، مصر .

يهدف هذا البحث إلى إجراء دراسات بيئية ذاتية على نبات **الكوخيا انديكا** وهو أحد الأنواع النباتية البرية التابعة للفصيلة الرمرامية . ويتضمن هذا البحث دراسة صور الحياة لهذا النبات منذ انبات بذوره في شهر فبراير حتى تكوين الأزهار والبذور الناضجة خلال شهر سبتمبر . ويعترى النبات تغيرات مظهرية يتبعها تغيير في اللون من الأخضر الداكن إلى اللون الأحمر في مراحله الأخيرة كما تم تحليل التربة التي ينمو بها النبات في عدة مناطق في الاسكندرية والمنصورة وطريق المنصورة ـ دمياط والخواص الطبيعية للتربة التي شملت التحليل الميكانيكي (باستخدام طريقة المناخل للتربة الرملية الخشنة وطريقة الهيدروميتر للتربة الناعمة) ومسامية التربة والسعة المائية ورطوبة التربة . أما الخواص الكيميائية فتضمنت التقدير الكمي لكربونات الكالسيوم ونسبة الكربون العضوي والأملاح الذائبة والكلوريدات والكربونات والكبريتات والرقم الهيدروجيني . ولقد أجريت دراسة تحليلية لأحد العشائر النباتية التي يسودها نبات **الكوخيا** باستخدام طريقة المربعات وسجلت أسماء النباتات وعددها ومدى ترددها والغطاء النباتي لكل نوع . كما أمكن دراسة أنسب الظروف ملاءمة لانبات البذور فعرضت لمستويات مختلفة من تركيز الملوحة وكمية المطر والاضاءة والعمق ويمكن أن نستخلص من تجارب الانبات الآتي :

(١) يتحمل النبات مدى واسعا من الملوحة تصل إلى ٠,٣ عياري كلوريد الصوديوم .

(٢) تزداد نسبة الانبات بزيادة كمية المطر التي تروى بها البذور .

(٣) بلغت نسبة الانبات أقصاها (٨٦ ٪) تحت تأثير الظلام المستمر وانخفضت إلى ٣٦ ٪ في الضوء المستمر . وبلغت ٩٤ ٪ عند تبادل التعرض للضوء والظلام .

(٤) تقل نسبة الانبات بزيادة العمق . وكانت أعلى نسبة إنبات على سطح التربة حيث بلغت ٨٨ ٪ وأقلها عند عمق ٢ سم ، ٣ سم حيث بلغت ٣٢ ٪ .

وكذلك درست مقاومة النبات للملوحة وتم تقدير الوزن الطازج والوزن الجاف للنباتات النامية في مستويات مختلفة من الملوحة . ولوحظ أنه لا علاقة بين الارتفاع وقيم الوزن الطازج والجاف لأن النباتات القصيرة أعطت وزنا طازجا وجافا أعلى من النباتات الطويلة . كما أن ازدياد تركيز محلول كلوريد الصوديوم إلى ٣ ٪ أدى إلى زيادة في الوزن الطازج والجاف .