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Ecological Studies on *Cicer arietinum L.* I. Growth Response of *Cicer arietinum L.* Grown on Two Types of Soil to N.P. Fertilization

A.Y.M. Basahy and Saeed Ahmad
Botany Department, College of Science, King Saud University, Saudi Arabia.

Effects of time of fertilizer application on the growth and development of the plant were studied using different types of soil. Three fertilizer treatments were applied:

1. Fertilizer before sowing (FBS).
2. Fertilizer immediately after germination (FIAG).
3. Fertilizer four weeks after germination (F4WAG).

FBS resulted in delayed as well as reduced germination as compared to control. Other growth characteristics, such as shoot and root length, number of branches, number of leaves, number of roots, and dry weight of shoot and root were also significantly reduced as compared with the controls in both types of soil used.

FIAG had neither a retarding, nor a promoting effect, on growth, the mean values of nearly all the characters studied being about the same as in the control, with a few exceptions, where the values were slightly higher than those of the control.

F4WAG produced the best results, the mean values of all the characters studied in this treatment being higher not only than those of the control, but also than those of treatments (FBS) and (FIAG). When comparing growth in the two types of soil used, sandy soil promoted better growth and development than sandy clay loam.

Cicer arietinum L., or "Humous" as it is locally known, is a very high protein crop and is an important contribution to human diet in different parts of the world. Apart from human consumption, it is also of considerable importance as cattle fodder.

Cicer is one of the oldest and most widely used grain leguminous seed crops in the Middle and Far East. Archeological finds reveal that the crop has been used since prehistoric times. *Cicer* is today cultivated in Pakistan, India, Italy, Greece, Roumania, Russia, Egypt, North Africa, Rhodesia, Iran, Turkey, Syria, Central, and South America and in parts of Australia (Van der Maesen 1972).

Cicer, being a drought-resistant plant needing very little water for cultivation and capable of growing in poor soil conditions, is quite suitable for cultivation in Saudi Arabia, but unfortunately very little or no attention has yet been paid to this crop.

The present study was conducted to investigate the possibilities of cultivating *Cicer* in different soils of Saudi Arabia.

Materials and Methods

Two types of soil, red sand and sandy clayloam, collected from Riyad Region were used in this present investigation, with the fertilizer (N.P.) applied at three developmental stages, namely before sowing (FBS), immediately after germination (FIAG), and four weeks after germination, (F4WAG). Pot experiments were conducted in the open, seeds being sown at approximately equal depths of 3 cm, in 17-cm pots, each pot containing five seeds equally spaced. There were 20 pots for control and 20 for each treatment, thus making a total of 100 plants for control and each treatment.

Before sowing, fertilizer was applied to one set of 20 pots for each of sandy and sandy clay loam soils, and germination counts were made daily for 14 successive days.

Immediately after germination, fertilizer was added to the second set of pots, both of sandy and sandy clay loam soils. Two weeks after germination, the first sample of 10 seedlings each were removed for each treatment as well as controls. Roots were very carefully washed and dried between two filter papers; the portion of seedlings above the ground was considered shoot and incised from the lower portion, which was considered as root. Shoot and root length were measured for each plant, and number of branches, leaves, and roots per plant were counted. Shoots and roots were weighed separately for fresh weight and samples of seedlings were dried at 100 °C in an oven for 48 h and then weighed for dry weight. Chemical analysis was carried out following the methods used by Allen and Whitfield (1965) for total nitrogen, Olsen *et al.* (1954) for phosphorous, and Black (1965) for available potassium, described by Basahy (1974). The results will be presented in Part 2. Second and third samples were taken at intervals of 6 and 10 weeks after

Table 1. Mean shoot length at 2, 6, and 10 weeks after germination in sand and sandy clay loam soils with three fertilizer treatments.

Shoot length	Soil type	Control	FBS	FIAG	F4WAG
Two weeks after germination	Sand	9.68±0.3864	6.21±0.3089	10.41±0.4615	—
	Sandy clay loam	5.50±0.364	3.51±0.6405	4.50±0.2389	—
Six weeks after germination	Sand	13.35±0.5329	8.45±0.6918	13.94±0.5580	16.09±0.5965
	Sandy clay loam	11.80±0.4359	8.73±0.7855	10.82±0.4231	10.43±0.4402
Ten weeks after germination	Sand	16.55±0.4244	12.07±0.3466	17.75±0.5123	20.20±0.5537
	Sandy clay loam	15.80±0.5227	11.33±0.7789	16.75±0.4901	17.75±0.5736

germination, and all the characteristics studied above were repeated for each sample. Mean value, standard error, and standard deviation were calculated for each criterion studied.

Results

Results are presented in Tables 1–8 and Fig. 1–6. The FBS treatment resulted in delayed as well as reduced germination. The shoot length recorded 2 weeks after

Table 2. Mean root length at 2, 6, and 10 weeks after germination in sand and sandy clay loam soils with three fertilizer treatments.

Root length	Soil type	Control	FBS	FIAG	F4WAG
Two weeks after germination	Sand	11.01±0.5990	4.82±0.4414	10.72±0.8447	—
	Sandy clay loam	5.76±0.3300	2.81±0.4257	6.31±0.4503	—
Six weeks after germination	Sand	12.40±0.7703	5.98±1.1966	13.10±0.7006	13.25±0.8173
	Sandy clay loam	8.64±0.4517	3.80±0.6544	7.76±0.7000	7.31±0.5906
Ten weeks after germination	Sand	16.95±0.7470	11.92±0.8777	18.90±0.6944	19.80±0.6919
	Sandy clay loam	12.20±0.5923	6.80±0.4320	9.25±0.5537	10.95±0.5014

Table 3. Mean number of branches at 2, 6, and 10 weeks after germination in sand and sandy clay loam soils with three fertilizer treatments.

Number of branches	Soil type	Control	FBS	FIAG	F4WAG
Two weeks after germination	Sand	0.80±0.2000	NIL	0.30±0.1527	—
	Sandy clay loam	NIL	NIL	NIL	—
Six weeks after germination	Sand	0.80±0.1333	1.37±0.2897	3.10	3.30
	Sandy clay loam	2.40±0.1632	1.22±0.3073	2.60±0.1632	2.70±0.2134
Ten weeks after germination	Sand	3.50±0.1666	1.85±0.2182	3.80±0.2494	4.10±0.2333
	Sandy clay loam	2.50±0.2236	1.16±0.2380	3.40±0.2211	3.30±0.2134

germination showed that the above treatment significantly reduced the plant height, as compared to control, in both the sand and sandy clay loam soil (Fig. 1). FIAG treatment resulted in slight increase in sand and slight decrease in sandy clay loam compared to control, but was not significant in either case. Records of height at 6 and 10 weeks after germination showed that the suppressing effects of FBS remained throughout (Fig. 1).

Table 4. Mean number of leaves at 2, 6 and 10 weeks after germination in sand and sandy clay loam soils with three fertilizer treatments.

Number of leaves	Soil type	Control	FBS	FIAG	F4WAG
Two weeks after germination	Sand	5.20±0.2491	3.30±0.2603	5.00±0.2978	—
	Sandy clay loam	3.20±0.1992	1.90±0.3788	2.80±0.1995	—
Six weeks after germination	Sand	30.40±1.3433	12.62±1.5394	31.40±1.1076	34.60±1.3351
	Sandy clay loam	23.50±0.9458	11.22±1.7014	23.40±0.7916	21.60±1.3516
Ten weeks after germination	Sand	43.80±1.1624	24.71±1.1650	46.20±1.3969	47.70±1.0960
	Sandy clay loam	36.30±1.2024	25.66±1.0520	42.40±1.1567	44.50±0.9458

Table 5. Mean number of roots at 2, 6, and 10 weeks after germination in sand and sandy clay loam soils with three fertilizer treatments.

Number of roots	Soil type	Control	FBS	FIAG	F4WAG
Two weeks after germination	Sand	21.80±0.9405	9.90±1.4867	23.10±0.9939	—
	Sandy clay loam	16.40±1.2221	8.40±1.26660	13.30±0.9781	—
Six weeks after germination	Sand	37.20±3.0472	12.87±2.5381	42.20±3.9409	39.40±2.8916
	Sandy clay loam	27.50±2.2175	11.00±2.3400	23.10±2.3640	18.80±0.9522
Ten weeks after germination	Sand	44.40±1.5507	18.00±1.1255	49.60±1.3516	47.30±0.9549
	Sandy clay loam	38.80±1.5833	15.50±1.1446	39.50±1.2584	37.10±1.3861

FIAG treatment gave about the same mean values for height as did control; however, F4WAG showed a statistically significant increase in height over control in both sand and sandy clay loam (Table 1). Root length measurements 2 weeks after germination showed reduced root length and fewer secondary roots (Fig. 2

Table 6. Fresh and dry weight of shoots and roots at 2 weeks after germination (mean values).

	Soil type	Control	FBS	FIAG	F4WAG
Fresh weight shoot	Sand	0.5153±0.0318	0.2559±0.0178	0.5178±0.0451	—
	Sandy clay loam	0.2699±0.0217	0.1902±0.0229	0.2274±0.0163	—
Dry weight shoot	Sand	0.0640±0.0054	0.0338±0.0060	0.0581±0.0079	—
	Sandy clay loam	0.0329±0.0035	0.0333±0.0047	0.0279±0.0045	—
Fresh weight root	Sand	0.2495±0.0191	0.1808±0.0189	0.2719±0.0266	—
	Sandy clay loam	0.1599±0.0138	0.0723±0.0118	0.1661±0.0109	—
Dry weight root	Sand	0.0339±0.0050	0.0214±0.0036	0.0345±0.0045	—
	Sandy clay loam	0.0244±0.0033	0.0164±0.0023	0.0239±0.0045	—

Table 7. Fresh and dry weight of shoots and roots at 6 weeks after germination (mean values).

	Soil type	Control	FBS	FIAG	F4WAG
Fresh weight shoot	Sand	2.7031±0.1444	0.7918±0.1457	3.3087±0.3110	3.5856±0.2194
	Sandy clay loam	1.9882±0.1037	0.9869±0.1633	1.7777±0.1667	1.5194±0.1568
Dry weight shoot	Sand	0.4881±0.0320	0.1479±0.0207	0.4537±0.0503	0.6261±0.0307
	Sandy clay loam	0.3497±0.0169	0.1972±0.0245	0.3701±0.0214	0.3452±0.0356
Fresh weight root	Sand	1.2252±0.1535	0.3034±0.0820	1.3903±0.2471	1.0575±0.2286
	Sandy clay loam	0.6283±0.0914	0.2214±0.0257	0.2977±0.0706	0.2325±0.0335
Dry weight root	Sand	0.1469±0.0112	0.0526±0.0125	0.1646±0.0155	0.1865±0.0179
	Sandy clay loam	0.0867±0.0088	0.413±0.0070	0.0674±0.0073	0.0624±0.0056

Table 8. Fresh and dry weight of shoots and roots at 10 weeks after germination (mean values).

	Soil type	Control	FBS	FIAG	F4WAG
Fresh weight shoot	Sand	2.7991±0.1733	1.0552±0.1023	2.8315±0.2411	3.0987±0.1776
	Sandy clay loam	2.4129±0.1459	0.9122±0.0745	2.5435±0.1370	2.6822±0.1692
Dry weight shoot	Sand	0.6681±0.0537	0.2429±0.0384	0.6926±0.0728	0.8157±0.1103
	Sandy clay loam	0.7370±0.0661	0.3132±0.0482	0.6819±0.0363	0.8529±0.0736
Fresh weight root	Sand	1.6697±0.1543	0.5913±0.1234	2.2992±0.1905	2.1119±0.2087
	Sandy clay loam	0.9576±0.0729	0.4164±0.0396	1.0179±0.0618	0.9809±0.0519
Dry weight root	Sand	0.2529±0.0349	0.1246±0.0365	0.2745±0.0373	0.2926±0.0367
	Sandy clay loom	0.1110±0.0128	0.0552±0.0092	0.1155±0.0167	0.1280±0.0239

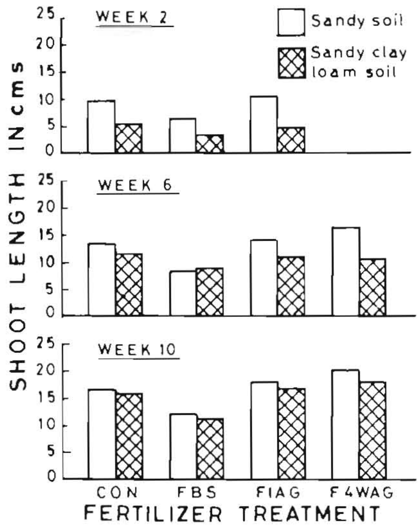

Fig. 1. Shoot length at 2, 6, and 10 weeks after germination in sand and sandy clay loam soils, with three fertilizer treatments.

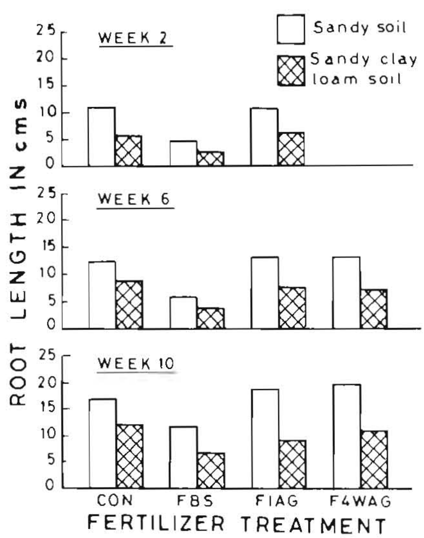

Fig. 2. Root length at 2, 6, and 10 weeks after germination in sand and sandy clay loam soils, with three fertilizer treatments.

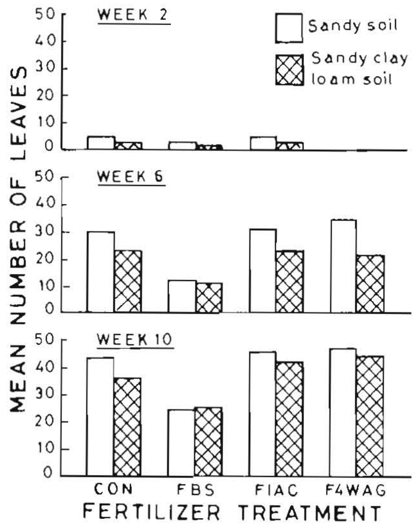

Fig. 3. Number of leaves produced at 2, 6, and 10 weeks after germination in sand and sandy clay loam soils, with three fertilizer treatments.

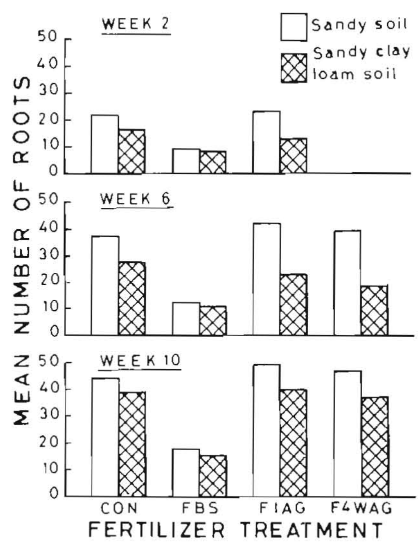

Fig. 4. Number of roots produced at 2, 6, and 10 weeks after germination in sand and sandy clay loam soils, with three fertilizer treatments.

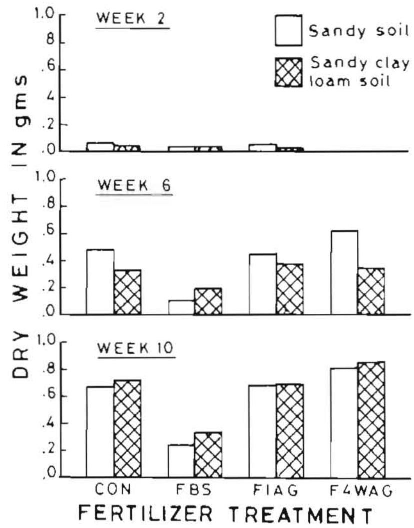

Fig. 5. Dry weight of shoot at 2, 6, and 10 weeks after germination in sand and sandy clay loam soils, with three fertilizer treatments.

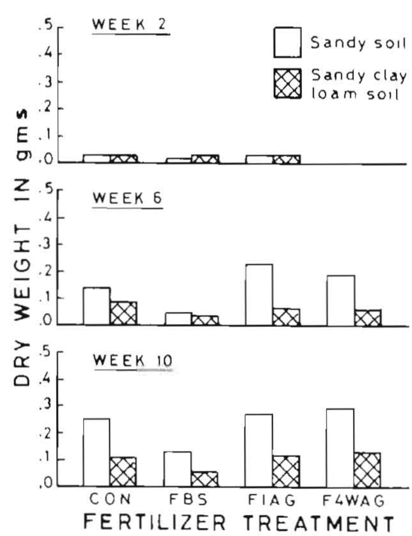

Fig. 6. Dry weight of root at 2, 6, and 10 weeks after germination in sand and sandy clay loam soils, with three fertilizer treatments.

and 4 and Table 5) than control in FBS treatment in both types of soils; however, FIAG resulted in about the same root length but slightly higher root number than control. Samples collected at 6 and 10 weeks showed that the root length and the number of roots remained lower than control in FBS treatment; however, in FIAG and F4WAG both the root length and the number of roots were significantly higher than the control in sandy soil, but lower in sandy clay loam.

In sandy clay loam soil, no branches were produced at 2 weeks after germination in FBS and FIAG treatments, as was the case with the control; however, in sand, 7 plants out of 10 in control, and 3 out of 10 in FIAG produced branches, but with non produced under FBS. At 6 and 10 weeks after germination (Table 3) the number of branches in FBS remained lower than in control, but was not much different in FIAG and F4WAG. There was hardly any difference in the number of leaves between control, FBS, and FIAG at 2 weeks from germination.

At 6 and 10 weeks FBS had fewer leaves than control, with FIAG and F4WAG showing higher leaf numbers than control in both types of soil; the differences were not statistically significant. When dry weight of shoot and root were considered the same trend appeared as in previous characteristics studied, weights being lower than control in FBS and about the same as control in FIAG at 2 weeks and dry weight of shoot at 6 weeks in F4WAG (Table 7 and Fig. 5) was higher than control in sandy soil only, but at 10 weeks was higher in both types of soil. Root dry weight showed a higher value over the control in treatment FIAG and F4WAG in sandy soil only.

Discussion

It is well known that application of fertilizer enhances growth if applied at a proper developmental stage, that is, when the plant can actively utilize the nitrogen for growth. With this in mind the present investigation was initiated using two types of soils: sand and sandy clay loam.

In both soil types the application of fertilizer before sowing resulted in delayed as well as reduced germination, and showed a retarding effect on all such developmental manifestations as shoot length, root length, number of leaves, number of branches, number of roots, as well as fresh weight and dry weight of shoot and root, studied in the present investigation. One explanation of this reduced growth rate can be that the nitrogen applied before sowing brought about the burning or salt effect on the roots of germinating seedlings. Above results are in line with Foote and Batchelder (1953), who reported that the application of nitrogen before ploughing was virtually ineffective and had a burning effect on the seedling of barley, whereas the nitrogen applied at 6-in. growth stage was very effective and resulted in significant increase in growth and yield components. In the present case the application of fertilizer immediately after germination, when the seedlings were about 1 to 2 cm tall also had favourable results, although no significant increase in growth-rate was observed, with few exceptions, where fertilized plants showed higher values than control in such characteristics as root length, number of roots, and root dry weight in sandy soil only. According to Foote and Batchelder (1953) the soil types with adequate available moisture show a good response to nitrogen fertilizer, but this was not true in the present investigation, as the sandy soil, with lower water holding capacity (25.92%) than sandy clay loam (34.61%) showed comparatively better growth rate. This can be traced to the different water requirements of different plant material; *Cicer* requires very little water as compared to other plants such as barley; Warder *et al.* (1963) also reported that the use of N.-P. fertilizer in experiments on wheat increased crop growth during the seedling stages on clay and loam soils. Knoch *et al.* (1957) found that nitrogen fertilizer increased winter wheat root weight at different moisture levels. A similar increase in root dry weight, over the control, is observed in the present study.

On the whole *Cicer* showed better growth in sand than in sandy clay loam (Fig. 1–6), with the only exception of shoot dry weight (Fig. 5), which was slightly higher in sandy clay loam than in sand. This can be partly due to the thicker stems in sandy clay loam.

Fertilizer applied 4 weeks after germination, when the seedlings were approximately 10 cm tall, produced the best results in both types of soil.

The present study is just a preliminary work undertaken to obtain information about the possibilities of cultivation of *Cicer* in Saudi Arabia. It is hoped that a more extensive investigation comprising yield components and nitrogen fixation in *Cicer* would be carried out in the near future.

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دراسات بيئية على الحمص ـ ١ ـ استجابة الحمص للنمـو فى نوعين مختلفين من التربة لتسميد الازوت الفسفورى •

عبد الله يحيى باصهى وسعيد احمد عبد الوهاب
قسم النباتات ـ كلية العلوم ـ جامعة الملك سعود ـ الرياض ـ المملكة العربية السعـــودية

ذرس تاثير موعد الزراعة على نمو وتكشف نبـــاتات الحمص بالزراعة فى نوعين مختلفين من التربة مع التسميد فى ثلاثـــة مواعيد مختلفه كالتالى :

- إضافة السماد قبل الزراعة •
- إضافة السماد بعد الإنبات مباشرة •
- إضافة السماد بعد مرور أربعة أسابيع من الإنبات •

ولقد نتج عن المعاملة باضافة السماد قبل الزراعة تأخير فى الانبات والنمو مقارنة بالمعاملة التى لم تتلق أى سماد حيث ظهر ذلك جليا فى اختزال حجم الجذور والسيقان والاوراق ، وعلى العكس من ذلك فان اضافة السماد بعد مرور أربعة أسابيع من الانبات قد نتج عنها نباتات أفضل نموا من سابقاتها • أما فى حالة المعاملة باضافة السماد بعد انبات البـذور فلم يلاحظ أى تأثير يذكـر •

كذلك أوضحت الدراسة أن أفضل تربة لـزراعة الحمص هى التربة الرملية •