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EFFECT OF SOME INTEGRATED FOLIAR FERTILIZERS  
ON NODULATION, NITROGENASE ACTIVITY, NITROGEN  
CONTENT AND YIELD OF VICIA FABA PLANTS  
IN SALINIZED CALCAREOUS SOIL

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EFFECT OF SOME INTEGRATED FOLIAR FERTILIZERS  
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EL-SHAKWEER, M.H.<sup>✉</sup>; FARAH, M.A.<sup>✉✉</sup> and BARAKAT, M.A.<sup>✉✉</sup>

ABSTRACT

Faba bean (*Vicia faba* L.) variety Giza 2 was planted on a calcareous soil in a pot experiment comprised treatments of salinized irrigation water of tap water, tap water + 500, + 1000, + 2000 and + 4000 ppm of salts and foliar fertilization treatments of Irral, Bayfolan, Volovertile and Compelesan. Nodules number and dry weight, nitrogenase activity, nitrogen content, shoot and root dry weight and yield components of faba bean plants were taken as criteria.

Salinity depressed differentially all plant characteristics examined. The grain yield was decreased to 56.2 % of the control value when the 4000 ppm salts in irrigation water was used. The size of a nodule increased with salinity while the size of a grain reached maximum weight under the 1000 ppm salts in irrigation water.

Among the tested fertilizers, Bayfolan proved to be more superior. Grain yield produced by Bayfolan was 35.4, 14.4, 16.8 and 24.7 % greater than that of the control, Irral, Volovertile and Compelesan respectively.

Using up to 4000 ppm salinity in irrigation water, Bayfolan still had higher promotive effect on nodules dry weight. With respect to grain yield, Volovertile, Compelesan and Bayfolan gave the highest yields at 1000, 2000 and 4000 ppm salts in irrigation water respectively.

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## INTRODUCTION

Agriculture is now extending to calcareous desert soils in Egypt. Such soils are known to have nutritional problems due to their high content of calcium carbonate ( Balba 1980 ). Secondary salinization due to inefficient drainage forms also another problem in those soils ( Elgabaly 1971 and Balba et al. 1975 ).

Faba bean is the common grain legume under Egyptian agriculture. It occupies about 300 000 feddans annually during winter season ( Ministry of Agriculture A.R.E., 1981 ). Under salt-affected calcareous soil conditions , the growth , nodulation , nitrogen fixation of this crop are still problematic . It is believed that proper fertilization is needed in order to get optimum growth and yield of faba bean under these conditions . Different foliar fertilizers are now in use to correct nutritional defects of soils ( Wallace 1971 , F A O 1979 , I F D C 1976 and Jones 1979 ) .

The purpose of the present work is to find out the effect of 4 foliar fertilizers commercially known as Irral , Bayfolan , Volovertile and Compelesan on the growth , nodulation , nitrogen fixation and yield of *Vicia faba* in salt-affected calcareous soil .

## MATERIAL AND METHODS

In a pot experiment under the green-house conditions , broad bean ( *Vicia faba* L. ) variety Giza 2 was raised on a calcareous soil sample collected from surface layer in Maryut area of Northern Sector of Tahreer Province . The soil was air-dried , sieved and packed in glazed pots of 23 cm. diameter and 36 cm. depth . The characteristics of the soil , as determined according to Black et al. (1965) were : clay 23.3 % , silt 40.8 % , fine sand 27.4 % , coarse sand 8.5 % ,  $\text{CaCO}_3$  26.2 % , organic matter 0.48 % , total nitrogen 0.05 % , available phosphorus 8.0 ppm , available potassium 445 ppm , electrical conductivity of saturated soil-water extract 0.55 mmhos/cm at 25°C and pH of saturated soil-water extract 8.4 .

Ten seeds were sown in each pot and after two weeks 5 plants were left in each pot . Tap water (  $\approx$  200 ppm soluble salts ) was used for irrigation during the first two weeks . Thereafter , irrigation waters used were : tap water , tap water + 500 , + 1000 , + 2000 and + 4000 ppm soluble salts . A mixture of NaCl and  $\text{CaCl}_2$  salts 1:1 wt/wt was used

for preparing the salinized irrigation water . To avoid salinity accumulation , calculated excessive amounts of irrigation water were applied .

With each salinity treatment 4 commercial foliar fertilizers were applied in addition to a control without foliar spraying . The composition of these foliars are as follows :

	<u>Irral</u>	<u>Bayfolan</u>	<u>Volovertile</u>	<u>Compelesan</u>
N %	20.0	11.0	22.0	9.66
P %	8.0	8.0	21.0	9.66
K %	16.0	6.0	17.0	7.24
Mg %	1.0	-	0.079	0.024
Fe %	0.03	0.0185	0.037	0.012
Zn %	0.1	0.0061	0.0061	0.006
Mn %	1.0	0.0162	0.0395	0.012
B %	0.5	0.0113	0.0033	0.012
Mo %	-	0.00095	0.005	0.006
Cu %	0.1	0.008	0.0076	0.012
Co %	-	0.00035	0.002	-
S %	1.0	Traces	-	-
Vitamin B <sub>1</sub>	-	Traces	-	-
Growth hormones	-	Traces	-	-

Four weeks after sowing , foliar spray started using solution containing 2000 ppm of the fertilizer . The plants received 5 sprays at intervals of 2 weeks . Four replicates were used for each treatment .

After 13 weeks of sowing , representative plants (5 plants/replicate) were uprooted . The root was dipped in water to remove soil particles, washed with distilled water , excised and subjected to the measurement of nitrogenase activity by the acetylene reduction technique ( Hardy et al. 1973 ) . The nodules on each root were counted and their dry weight was determined . Total nitrogen content of plant components ( root, shoot and nodules ) were determined according to Jackson ( 1961 ) .

At harvest ( 22 weeks of sowing ) yield components ( number and dry weight of pods and grains ) were recorded .

Statistical analysis was carried out according to Steel and Torrie ( 1960 ) .

## RESULTS AND DISCUSSION

Results are summarized in Tables 1 and 2 . At the age of 13 weeks, Table 1 shows the mean values of nodulation ,  $N_2$ -ase activity , nitrogen content , dry weights of shoot and root of faba bean plant for different salinities in irrigation water on average foliar fertilizer treatment, and for different foliar fertilizer treatments on average salinity treatments. Table 2 shows the mean values of pods and grains yield at the harvest for the same treatments as above .

Nodulation ( number and dry weight of nodules per plant ), nitrogenase activity , nitrogen content of plant , dry weights of shoot and root ( Table 1 ) , number and dry weight of pods and grains per plant (Table 2), all were depressed by increasing salinity in the irrigation water . The relative depression by salinity is given in Figure 1 . The figure shows that the most to suffer from salinity was the root as it decreased to 75.5 % of the control under the 4000 ppm salt treatment . The next was the number of nodules as it decreased to 63.5 % of the control value . The dry weight of nodules was not affected as much ( the decrease was only 38.0 % ). A noticeable increase in a nodule size was denoted by increasing salinity of irrigation water ( 2.24 mg/nodule at the salinity control compared to 3.81 mg/nodule at the 4000 ppm salinity treatment) . The depression in number and dry weight of pods and grains yield was very close to that in the dry weight of nodules ( 37.3 , 36.9 , 38.9 and 43.8 % of the control value respectively ) . That in shoot weight and in nitrogen content were also very close ( 49.5 and 52.6 % of the control value ) . It may be also noticed that the average size of a grain seemed to reach its optimum weight ( 0.74 g.) at the 1000 ppm salinity treatment . These results are in agreement with those of Kamel et al. (1971), Sprent (1972), Subba Rao et al. (1974), F A O (1976), Abdel-Ghaffar et al.(1981), Zaghloul (1981) and Abdel-Ghaffar (1982) .

With respect to the effect of foliar fertilizer treatments, on average salinity of irrigation water treatments , on these plant characteristics as shown in tables 1 and 2 and figure 2 , it is apparent that all foliar fertilizers resulted in an increase of nodulation ,  $N_2$ -ase activity , N-content , growth vigour and yield of pods and grains . Among these foliars Bayfolan seemed superior to all . The grain yield produced by Bayfolan was 35.4 , 14.4 , 16.8 and 24.7 % greater than those of the control , Irral , Volovertile and Compelesan respectively . Bayfolan seemed therefore more nutritionally balanced with regard to faba bean

Table 1- Effect of salinity of irrigation water and foliar fertilizers on nodulation, N<sub>2</sub>-ase activity, N content and growth vigour of faba bean at the age of 13 weeks.

Treatment	Nodulation		N <sub>2</sub> -ase activity µmole C <sub>2</sub> H <sub>4</sub> / plant/hr.	N Content mg./plant	Shoot g./plant	Root g./plant
	No./plant	Dry wt., mg./plant				
<u>Salts added to tap water, ppm :</u>						
0	115	258	17.6	540	19.4	9.4
500	91	238	15.9	451	17.5	7.6
1000	73	216	14.0	387	15.9	6.5
2000	59	192	11.8	295	13.4	4.3
4000	42	160	9.7	256	9.8	2.3
L.S.D.0.05	8.1	12.2	1.2	36.1	0.6	0.7
<u>Foliar fertilizers :</u>						
Control	63	18.4	12.1	322	13.1	4.0
Irral	76	219	13.5	392	15.6	6.8
Bayfolan	93	235	15.5	443	18.3	8.0
Volovertile	78	219	14.3	393	14.8	5.9
Compelessan	70	207	13.7	379	14.1	5.3
L.S.D.0.05	8.1	12.2	1.2	36.1	0.6	0.7

Note: Each value within the table is the mean of 100 plants (5 treatments x 4 replicates x 5 plants).

Table 2- Effect of salinity of irrigation water and foliar fertilizers on yield of faba bean.

Treatment	Pods		Grains	
	No./plant	Wt.,g./plant	No./plant	Wt.,g./plant
<u>Salts added to tap water , ppm :</u>				
0	5.9	14.9	18	11.2
500	5.4	13.7	15	10.7
1000	5.0	12.8	14	10.3
2000	4.5	11.8	13	8.8
4000	3.7	9.4	11	6.3
L.S.D <sub>0.05</sub>	0.3	0.5	0.9	0.5
<u>Foliar fertilizers:</u>				
Control	4.2	10.8	12	8.2
Irral	5.2	13.1	15	9.7
Bayfolan	6.0	14.0	17	11.1
Volovertile	4.6	12.8	15	9.5
Compelesan	4.6	11.7	14	8.9
L.S.D <sub>0.05</sub>	0.3	0.5	0.9	0.5

Note: Each value within the table is the mean of 100 plants (5 treatments x 4 replicates x 5 plants).



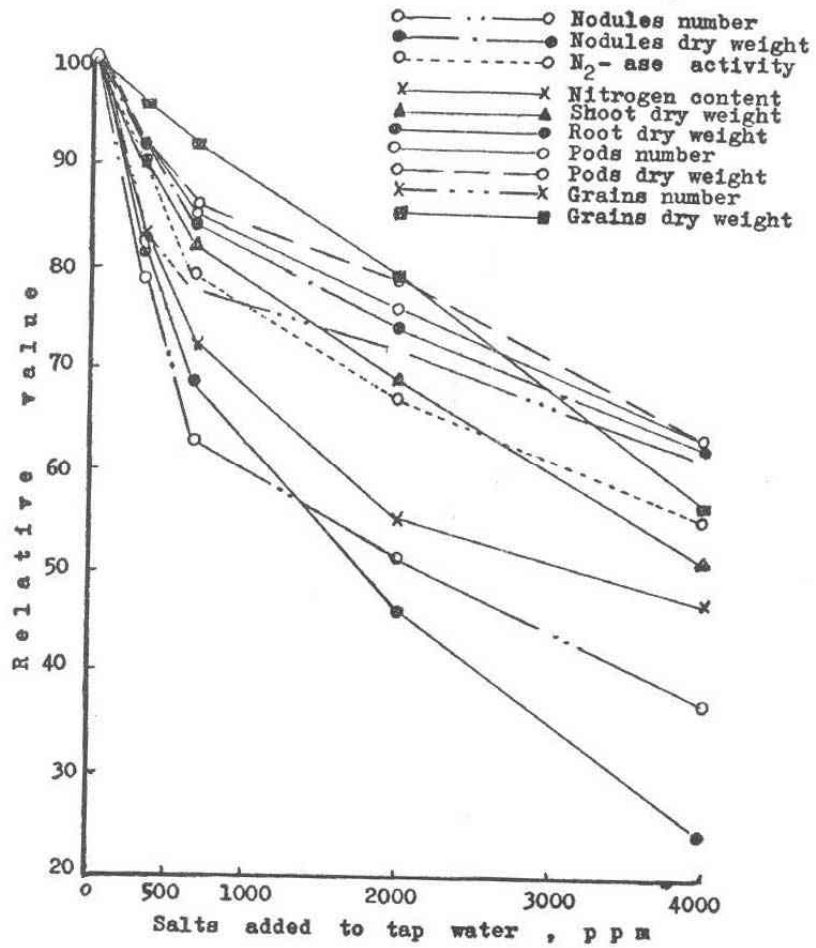


Figure 1 : Relative depression by salinity of irrigation water on characteristics of faba bean plants .

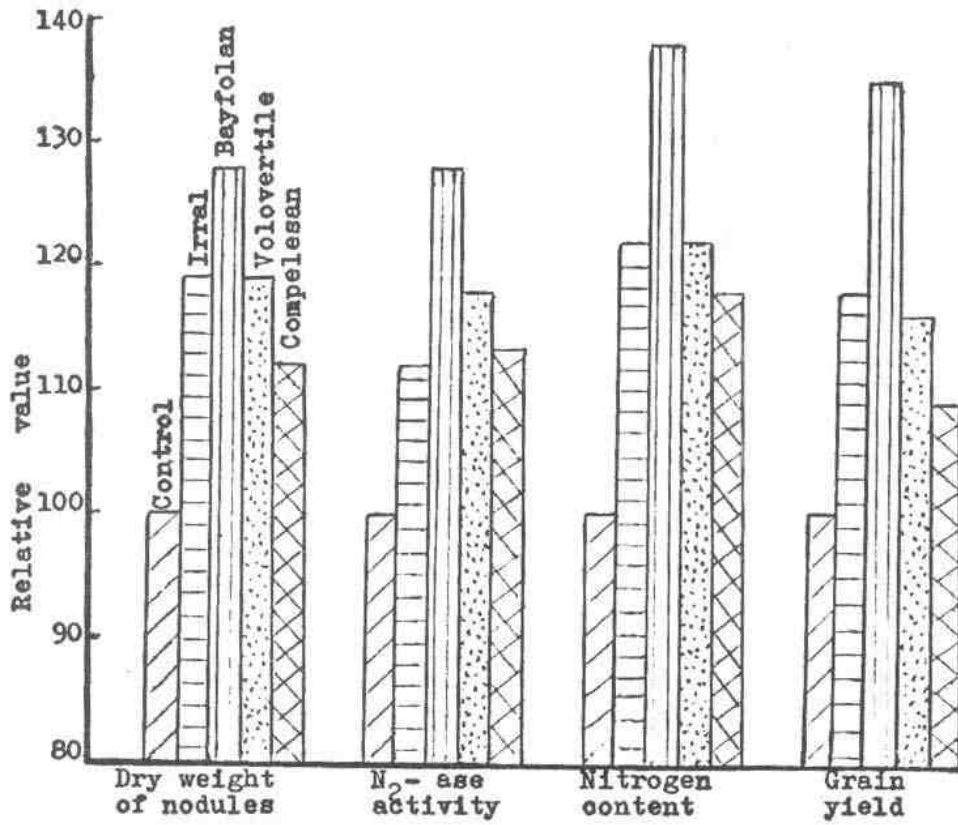


Figure 2 : Relative amelioration effect by foliar fertilizers on dry weight of nodules , N<sub>2</sub>-ase activity , nitrogen content and grain yield of faba bean plants .

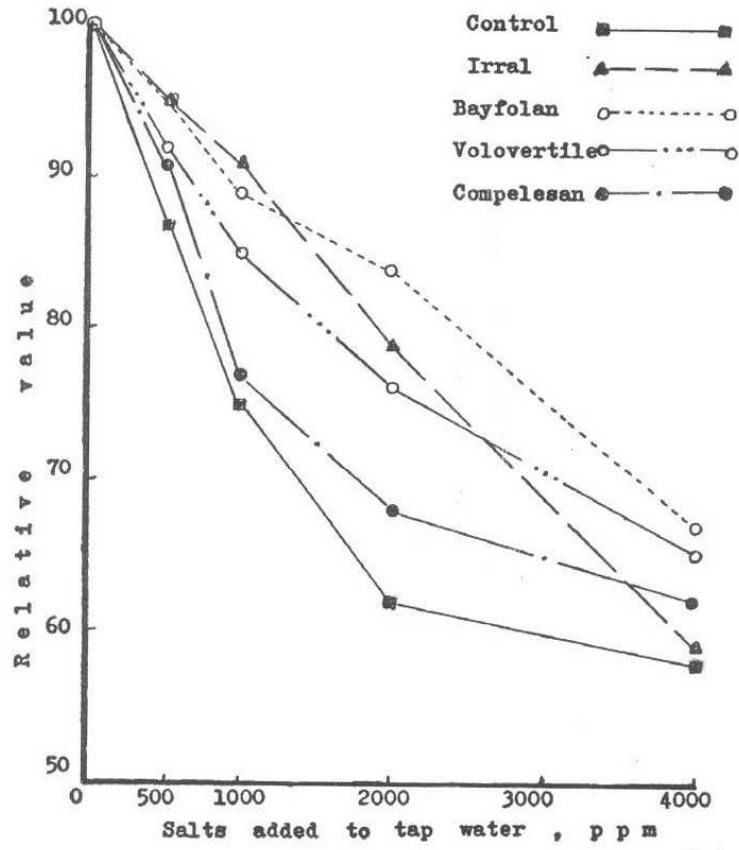


Figure 3 : Effect of foliar fertilizers on nodules dry weight of faba bean plants ( 13 weeks age ) at different salinities of irrigation water .

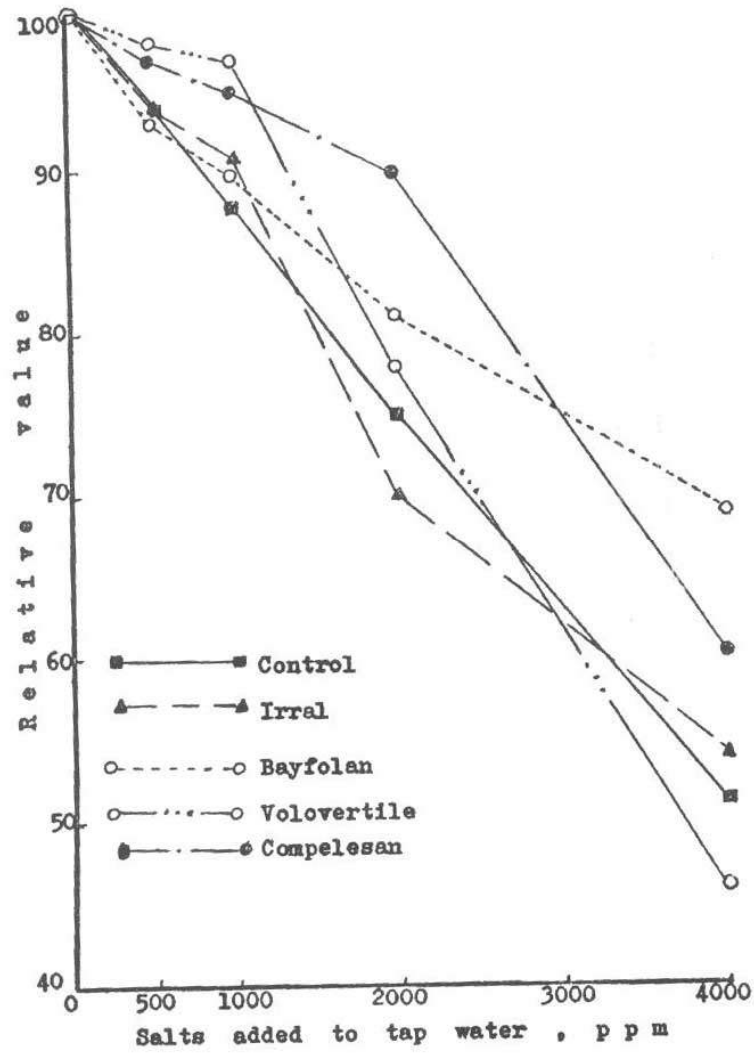


Figure 4 : The effect of foliar fertilizers on grains weight of faba bean plants at different salinities of irrigation water .

plants , It is agreed that the response of a crop to foliar fertilization depends on the nature , composition and dose of the foliar and on its interaction with soil and environmental factors ( Vincent 1965, Wallace 1971 , F A O 1979 , Jones 1979 and Child 1981 ) .

Analysis of variance revealed also significant salinity X foliar interaction effects on all of the plant characteristics examined . Foliar effects fluctuated between ameliorating and deteriorating the salinity effects but the magnitude of such an effect, however , was found to be of little value especially with respect to the number of nodules ,  $N_2$ -ase activity and N content . Of the rest , the dry weight of nodules and of course the grain yield are much more important . Their relative values for different foliars at the different salinity treatments are shown in figures 3 and 4 respectively . Figure 3 shows that at the 1000 ppm salinity treatment Bayfolan foliar fertilizer gave higher value of dry nodules than Irral than Volovertile than Compelesan which gave nearly the same value to that of the control . At the 2000 ppm salinity treatment , the differences between foliars became greater in the order : Bayfolan > Irral > Volovertile > Compelesan > the control . At the 4000 ppm salinity treatment the difference between the foliars was depressed but still Bayfolan had the greater value and Irral equalled the control . With respect to grain yield , Figure 4 shows that Volovertile , Compelesan and Bayfolan had higher amelioration effects at the 1000 , 2000 and 4000 ppm salinity treatments respectively . It may be noticed that at the higher salinity treatment Volovertile failed , however , to improve grain yield . It is agreed that optimum fertilization has an ameliorative effect on growing plants while the nutritionally unbalanced fertilizers may deteriorate the growth ( Jones 1979 ) .

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### البلخص العسرى

تأثير بعض اسمه الرش الورقية المتكامله على تكوين العقد الجذرية ونشاط  
انزيم نيتروجينيز ومحتوى الازوت ومحصول نبات الفول فى ارض جيرية متملحة

د . محمد حماد عطيه الشقير      د . ميشيل عزيز فرح      د . د . محمد عبدالفتاح بركات  
كلية الزراعة بالفيوم      معمل بحوث الاراضى الملحية والقلوية      مركز البحوث الزراعية - وزارة الزراعة  
جامعة القاهرة

زرع الفول الهلدى صنف جيزه ٢ فى ارض جيره فى تجره قصارى شملت معاملات  
مياه رى ملحية هى مياه صنوبر ، مياه صنوبر + ٥٥٠٠ + ٤١٠٠٠ + ٤٢٠٠٠ + ٤٠٠٠  
جزء فى المليون من الاملاح ومعاملات تسميد ورقى باسمه ايرال وايغولان وفوليفرتيل  
وكومبيلسان . وقدر عدد العقد الجذرية ووزنها الجاف ونشاط انزيم نيتروجينيز  
والمحتوى الازوتى والوزن الجاف للجذر والجموع الخضرى ومكونات المحصول للنباتات  
المزروعة .

اثر ملوحة مياه الرى بالنقص على جميع خواص النبات المختبره بدرجات متفاوتة  
وقد نقص محصول الحبوب ٥٦,٢ % عن معاملة المقارنة عند ٤٠٠٠ جزء فى المليون من  
الاملاح . وازداد حجم العقد الجذرية مع زيادة الملوحة وبلغت الحبة اقصى وزنها  
عند معاملة ١٠٠٠ جزء فى المليون من الاملاح .

وكان سماد بايغولان افضل الاسمده المختبره . وكان محصول الحبوب الناتج  
من المعاملة بالبايغولان يزيد بنسبة ٣٥,٤ + ١٤,٤ + ١٦,٨ + ٢٤,٧ % عن محصول  
معاملات المقارنة والايرال والفوليفرتيل والكومبيلسان على التوالى .

وحتى تركيز ملوحة مياه رى ٤٠٠٠ جزء فى المليون كان البايغولان ما يزال له  
اعلى تأثير محسن على الوزن الجاف للعقد الجذرية . وكان الفوليفرتيل والكومبيلسان  
والبايغولان لها اعلى تأثير محسن على وزن الحبوب عند معاملات مياه الرى ذات ١٠٠٠ +  
٢٠٠٠ + ٤٠٠٠ جزء فى المليون من الاملاح على التوالى .