Araştırma Makalesi

www.ziraat.selcuk.edu.tr/ojs
Selçuk Üniversitesi
Selçuk Tarım ve Gıda Bilimleri Dergisi
25 (2): (2011) 57-63
ISSN:1309-0550

Yeni Kumsal Toprakta Yapraktan Uygulanan Üre ve Potasyum Dihidrojen Ortofosfatın Bakla Verim ve Kalite Üzerine Etkisi

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(Geliş Tarihi: 28.10.2010, Kabul Tarihi:28.01.2011)

Özet

Kumsal topraklarda iki deneme şeklinde 2008-2009 ve 2009-2010 kış sezonlarında yapılan çalışma Mısır'da El-Bahara Valiliği, Nubaria Bölgesi'nde bulunan Ulusal Araştırma Merkezi Deneme Tarlasında iki yıl süreyle yürütülmüştür. Çalışmanın amacı yapraktan uygulanan üre (% 0, % 0.5 ile 10 g/lt ve 5 g/lt dozlarında) ve potasyum dihidrojen ortofosfatın % 0, 0.25, 0.50 ve 1 dozlarında (0, 2.5, 5 ve 10 g/lt) bakladaki verim ve verim bileşenlerine (cv. Giz-461) ve bazı kimyasal bileşenlere etkisini incelemektir.

Baklaların % 0.5 üre ile spreylenmesi bitki boyu, bitkide bakla sayısı, bitki başına tohum verimini dikkate değer derecede artırdığı kadar, yine her faddan biyolojik verimin de muamele yapılmayan kontrol gurubundan daha yüksek olduğu tespit edilmiştir. Çalışmada % 0.5 üre + % 0.25 PDO ile spreyleme yapılan muamelede ise bitki başına bakla sayısı (7.00) ve bitki başına tohum verimi (11.57 g) yönünden en yüksek değere ulaşılmıştır. Bakla tohumlarında en yüksek N, K ve Fe içerikleri bitkilerin % 0.5 PDO ile spreylendiği muameleden elde edilmiştir. Kombine uygulamalardan ise % 0.5 üre ile PDO tohumdaki Zn ve Mn oranları yönünden en yüksek değere sahip olmuştur.

Anahtar Kelimeler: *yapraktan uygulama, potasyum dihidrojen ortofosfat, bakla, verim, tohum kalitesi*

Effect of Foliar Application with Urea and Potassium Dihydrogen Orthophosphate on Faba Bean Yield and Quality in Newly Sandy Soil

Abstract

Two field experiments were carried out in sandy soil of the Experimental Farm of the National Research Center, Nubaria District, EL-Behara Governorate, Egypt, during the two winter seasons of 2008/2009 and 2009/2010. The aim of the study was to investigate the effect of foliar application of urea (U) at (0 and 5g/liter) and potassium dihydrogen orthophosphate (PDO) at (0, 2.5, 5 and 10 g/1itre) on faba bean yield and its components (cv. Giza-461) as well as some chemical constituents. Spraying faba bean plants with 5g/L urea significantly increased plant height, number of pods/ plant, seed yield/plant as well as biological yield per faddan compared with the untreated control. Potassium dihydrogen orthophosphate (PDO) foliar application significantly increased all the yield parameters compared with control. Spraying faba bean with (5g/L U + 2.5g/L PDO) recorded the highest number of pods per plant (7.00) and seed yield/ plant (11.57g). The highest N, K and Fe contents in seeds of faba bean were obtained when the plants were sprayed with (5g/L PDO), while the combined application of (5g/L U +5g/L PDO) produced the highest values of Zn and Mn in seeds.

Key words*: foliar application, urea, potassium dihydrogen orthophosphate, faba bean, yield, seed quality*

Introduction

Faba bean *(Vicia faba L.)* is one of the most important winter crops of high nutritive value in the world as well as in Egypt. Mature seeds of faba bean are good source of protein (about 25% in dried seeds), starch, cellulose, vitamin C and minerals (Hamilton, 2005). Therefore, it has an increasing importance for human and animal food in the future. Increasing the crop production is one of the most important targets of agricultural policy in Egypt and increasing cultivation in new reclaimed desert lands but these soils are characterized with poor fertility, low water holding capacity, high leaching and high pH value. In Egypt the balance between the production and the consumption of faba bean represented about 60 % of the national demands. For this reason efforts should be directed towards increasing and improving the faba bean yield, in order to fill the gap between production and consumption. Therefore, increasing the plant productivity is one of the main targets in Egyptian agricultural policy; this could be achieved through Soltanpour and Woekman (1979). Thus, the soil application of fertilizers like NPK may lead to some losses of these fertilizers that reflecting on yield and its components, quality and environment.

Moreover, fertilizers costs are considered of the main constraints to increase the economic yield of crops and efforts are needed to minimize its losses and to en-

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hance its economic use. Foliar feeding technique, as a particular way to supply these nutrients could avoid these factors and result in rapid absorption. It puts the plants in position to utilize soil –derived nutrients better and it is also less likely to result ground water pollution. The primary objective a foliar application is to allow for maximum absorption of nutrients into the plant tissue. Most suitable for this purpose are urea as a nitrogen fertilizer and Mono potassium phosphate (KH_2PO_4) as PK fertilizers (Kamburova *et al* 2009).

Foliar application of fertilizer should be viewed as temporary or emergency solution only but still it showed excellent results in some crops. The foliar application method is usually preferred because very small amounts of fertilizers are applied per unit area. Foliar application is also less likely to result in ground water pollution. The positive effect of supplying legume plants with supplementary late nitrogen was found to be beneficial effect on enhancing growth and increasing seed yield.

Many investigators concluded that foliar application of urea at growth stage increased yield and seed content of protein Attia and El-Dsouky (2001), Ahmed *et al*., (2003) Zeidan (2003), El- Kramany and Gobarah, (2005) on faba bean and Amany A. Bahr (2007) on chickpea. Recently, Parvez *et al.,* (2009) and Yassen *et al*., (2010) revealed that spraying wheat plants with 1% urea increased grain and straw yields, grainweight, biological yield, grain micronutrients concentration and uptake as well as grain-protein content.

Based on the available review, it is well known that the important role of phosphorus on growth and high yield with good quality. It plays a key role in metabolic processes. High pH in sandy soil affects the absorption ability of phosphorus therefore foliar application by phosphorus may be avoid this problem. Many researchers showed that positive effect of phosphorus fertilizer on legume plants (Mohammad and Chaudhary (2004) on lentil, Al-Fageh and Mehasen (2006), Ahmed and El-Abagy (2007), Yilmaz (2008), El-Gizawy and Mehasen (2009), Alderfasi and Alghamdi (2010) on faba bean).

Potassium (K) is an essential macro-element required in large amounts for normal plant growth and development. This attributed to the role of K in plant biochemical pathways Marschner (1995). Potassium increases the photosynthetic rates of crop leaves, CO_2 assimilation and facilitates carbon movement Sangakkara *et al*., (2000). Furthermore, K has an important role in the translocation of photosynthates from sources to sinks Cakmak *et al*., (1994). Numerous studies confirmed positive response for potassium foliar fertilizers on legume Yakout and Greish (2002) on faba bean, Mohammad and Chaudhary (2004) on lentil, Thalooth *et al*., (2006) on mung bean, Nelson and Motavalli (2007) on soybean. Recently, Mallarino (2009) concluded that foliar applications with potassium improve growth, grain yield and nutrient uptake on soybean.

The main objective of the present study is to determine the effect of foliar application with urea and potassium dihydrogen orthophosphate (PDO) fertilizer on yield, its components and quality of faba bean plants in sandy soil.

Materials and Methods

Two field experiments were carried out at new reclaimed sandy soil in the Experimental Farm of the, National Research Centre, at Nubaria District ,located EL- Behara Governorate, Egypt, during the two winter seasons of 2008/2009 and 2009/2010 to study the effect of foliar application by urea and potassium dihydrogen orthophosphate (PDO) on yield and its components of faba bean as well as some chemical constituents.

Some physical and chemical analysis of soil samples at 30 cm depth in experimental sites before soil preparation was determined according to Chapman and Pratt (1978) is presented in Table 1.

The experimental design was split- plots design with three replicates and the plot area was 10.5 m^2 consisting of five rows (3.5m length and 3m width).Urea foliar application at (0 or 5g/liter) were assigned to the main plots and foliar application by potassium dihydrogen orthophosphate (0, 2.5, 5 or 10 g/1itre) were randomly distributed in the sub plots.

A uniform basal dressing of phosphatic fertilizer as calcium super phosphate (15.0 % P_2 O_5) at a rate of 150 kg /fad was applied during seed-bed preparation.

Table 1. Mechanical and chemical analysis of the soil of the experimental site.

Mechanical and chemical analysis	
Sand (%)	90.80
Silt (%)	4.00
Clay (%)	5.20
Texture	sandy
Organic matter%	0.24
pH	8.66
EC (ds/m)	0.11
$CaCO_3$ (%)	5.20
Macro nutrients(mg/100g)	
N	4.50
P	0.12
K	9.22
Ca	80.00
Mg	18.20
Na	13.18
Micro nutrients(ppm)	
Fe	8.15
Zn	9.12
Mn	0.10
Cu	0.20

The seeds of faba bean (cv. Giza-461) were inoculated with the specific rhizobium strain and immediately sown at the first week of November in the two seasons then 15 kg N/fad. as ammonium nitrate 33% N was applied and irrigated just after sowing using sprinkler irrigation system. Foliar spraying with urea and potassium dihydrogen orthophosphate was applied twice, at the beginning of flowering stage (45) days and the second at pod development stages (60). The normal agronomic practices of growing faba bean were practiced till harvest as recommended by Legumes Research Dept. A.R.C., Giza.

The following treatments were applied:

T1=Control Treatment (Tap water).
T2=Foliar application of 5g/L urea
T3=Foliar application of 2.5g/L (PDO)
T4=Foliar application of 5g/L (PDO)
T5=Foliar application of 10g/L (PDO)
T6=Foliar application of 5g/L urea +2.5g/L (PDO)
T7= Foliar application of 5g/L urea + 5g/L (PDO)
T8= Foliar application of 5g/L urea +10g/L (PDO)

At Harvest ten random samples guarded plants in each plot were taken to determine the following characters:

1-Plant height (cm) 2-Number of pods/plant
3-Seed yield/plant (g) 4-100-seed weight (g)
5-Seed yield (kg/fad) 6- Biological yield (kg/fad)
7-Harvest index (%)

In addition, seed, straw and biological yields “kg/fad” were determined from the whole area of experimental unit and then converted to yield per fad. Harvest index (seed yield/biological yield /fad).

Chemical analysis

Nitrogen was determined by the Micro-kjeldahl method ADAS, (1981) using steam distillation unit "Gerhardt vapodest ". For determination of the other nutrients, one gram/sample was wet –digested with a mixture of 4:1by volume conc. Nitric (approx.70%) and perchloric (approx.60%) acids ADAS, (1981). Nutrient concentrations were measured using a spectrophotometer (Perkin-Elmer Lambda2) through the vanado -molybdate reaction for P Chapman and Pratt, (1978), a flamephotometer (Jenway PFP7) for K and Ca and an atomic absorption spectrometer (GBC932AA) for Mg and micronutrients.

All results were statistically analyzed according to Snedecor and Cochran (1990). The combined analysis was conducted for all data of the two seasons according to Steel and Torrie (1980). The least significant differences (L S D) were used to compare the means.

Results and Discussion

Yield and yield components

Data presented in Table 2 shows that foliar application of urea at 5g/L resulted in taller plant, greater number of pods /plant, higher seed yield /plant. From the same table it is clear that foliar application of urea at 5g/L significantly increase seed yield/fad (75.40kg) compared with control (tap water). Biological yield per faddan show significant differences of foliar application with urea. Biological yield increases about 10% compared to control.

Table 2. Effect of foliar application with urea on yield and its components of Faba bean

	Yield and its components						
Treatments	Plant height (cm)	Number of pods/plant	Seed yield/plant (g)	Seed index (g0	Seed yield (kg/fad)	Biological yield (kg/fad)	Harvest index (%)
without Urea (tap water)	71.42	5.17	9.08	70.91	666.71	1453.80	46.0
5g/L Urea	79.33	5.50	9.88	73.02	742.11	1619.18	45.8
LSD 5%	2.58	ns	0.46	ns	47.27	48.11	ns

* Faddan=4200m^2

The positive effects of foliar application with urea on yield parameters may be due to the stimulating effect of urea through improving the physiological performance of plants and multiple advantage of foliar application method such rapid and efficient response to plant needs, less product needed and independence of soil conditions Yildirim *et al*., (2007). Similar results were observed by Ahmed, *et al*., (2003) and El-Kramany and Gobarah (2005) reported that foliar fertilization with urea increased plant height and seed yield /plant. The increase in seed yield /fad may be due to the provision of N through urea spray at later growth stages which might have enhanced accumulation of assimilates in the seeds. The high efficiency of foliar urea application reported in this study is in agreement with the findings of El-Kramany and Gobarah, (2005) on faba bean and Amany, Bahr (2007) on chickpea. The increment of biological yield could be attributed also to the improvement of the mineral status of plants and increase yield. Our results are similar to the studies reported by (Parvez *et al*., 2009 and Yassen *et al*., 2010) mentioned that biological yield increased when the wheat plants spraying with urea.

The data presented in Table 3 show that foliar application of potassium dihydrogen orthophosphate (PDO) significantly increased all the yield parameters compared with control (tap water). Foliar application with PDO had the greatest stimulatory effect on plant height, number of pods /plant and weight of

seeds/plant. Maximum plant height of 82.67cm was recorded when 5g/L PDO solution was sprayed while the minimum plant height of 68.67 cm was recorded in control (tap water).

Table 3. Effect of foliar application with potassium dihydrogen orthophosphate on yield and its components of Faba bean

	Yield and its components						
Treatments	Plant height (cm)	Number of pods/plant	Seed yield/plant (g)	Seed index (g)	Seed yield (kg/fad)	Biological yield (kg/fad)	Harvest index (%)
Control(tap water)	68.67	4.67	8.36	67.54	623.25	1321.33	47.1
2.5g/L	75.67	6.67	10.87	74.78	823.45	1690.23	48.8
5g/L	82.67	4.67	9.17	71.68	670.00	1508.07	44.7
10g/L	74.50	5.33	9.54	73.86	700.94	1626.32	43.0
LSD 5%	4.12	0.95	0.65	2.50	49.43	82.49	1.20

Foliar application of 2.5g/L PDO solution recorded the highest seed weight /plant (12.21g) followed by 10g/L PDO solution (9.54g), while control treatment (tap water) produced the lowest seeds weight (8.13g). Possible explanation for increased seed weight due to the application of P is that nutrient may activate the biological reaction in faba bean plant, particularly photosynthesis fixation of CO_2 and synthesis of sugar and other organic compounds Marschner (1995)

These results show that potassium dihydrogen orthophosphate (PDO) seems to have a favorable impact on yield components, including number of pods / plant and 100seeds weight, leading to a higher faba bean seed yield/ plant. Biological yield increases ranged between 11 and 27% over control treatment. The lowest increment (11%) resulted from spraying plants with 5g/L PDO, whereas, the highest (27%) was obtained from spraying the plants with 2.5g/L PDO. Similar results support the obtained results Alderfasi and Alghamdi (2010) who reported that P and K fertilization markedly increased seed yield of faba bean and improved seed quality.

Data presented in Table 4 reveal that the interaction between urea and potassium dihydrogen orthophosphate (PDO) had a significant effect on all yield parameters except number of pods /plant and seed index. Foliar spraying with (5g/L U +2.5g/L PDO) produced the highest number of pods per plant (7.00) and the highest weight of seed /plant (11.57g), while the combination of (5g/L U +5g/L PDO) gave the tallest plants (82.33 cm).

Table 4. Effect of interaction between foliar application with urea and potassium dihydrogen orthophosphate on yield and its components of Faba bean

		Yield and its components						
Treatments		Plant height (cm)	Number of pods/plant	Seed yield/plant (g)	Seed index (g)	Seed yield (kg/fad)	Biological yield (kg/fad)	Harvest index (%)
Without Urea	Control	60.67	4.67	8.31	66.45	614.00	1310.97	46.8
	2.5g/L	69.33	6.33	10.17	72.90	754.00	1514.27	49.8
	5g/L	83.00	4.67	9.30	69.03	681.20	1413.42	48.2
	10g/L	72.67	5.00	8.54	75.27	617.63	1576.53	39.1
Urea at 5g/L	0	76.67	4.67	8.41	68.63	632.50	1331.70	47.5
	2.5g/L	82.00	7.00	11.57	76.67	892.90	1866.20	47.9
	5g/L	82.33	4.67	9.03	74.33	658.80	1602.71	41.1
	10g/L	76.33	5.67	10.53	72.45	784.25	1676.11	46.9
LSD 5%		5.83	ns	0.92	ns	69.91	116.65	1.70

The combined effect of foliar application of urea and potassium dihydrogen orthophosphate (PDO) significantly increased in seed and biological yields per feddan as well as harvest index. The highest values of seed and biological yields (kg /fad) were recorded when faba bean plants were foliar sprayed with (5g/L U +2.5g/L PDO), while control treatment (tap water) recorded the lowest values.

These results may point out that foliar application with urea and potassium dihydrogen orthophosphate (PDO) partially alleviates the adverse effects of shortage fertility and escape from P fixation problems in such soils. Some investigators indicted that foliar application of N and/or P & K fertilizers can increase yields, but should only be considered as a supplement to balanced soil-applied plant nutrition program, based

on soil tests and realistic yield goals. (Alderfasi and Alghamdi (2010) In addition, nutrients play a pivotal role in increasing the seed yield in pulses. Foliar application of major nutrients like nitrogen and potassium was found to be as good as soil application. According to Mitra *et al*. (1988), nitrogen is the major limiting factor for yield in mungbean. Several reports (Kalita *et al*., 1994) suggested that supplementing urea at the reproductive stage significantly enhanced the seed yield by delaying leaf senescence in Peas.

Chemical constituents

Figure 1 illustrate that all foliar application treatments of urea with or without PDO resulted in increased seed- N concentration of faba bean compared to the control. The highest nitrogen content in seeds was recorded when the plants were treated with 5g/L PDO. Maximum phosphorus concentration was obtained from the combinations of (5g/L U + 2.5g/L PDO) .Also; the control treatment gave the lowest values.

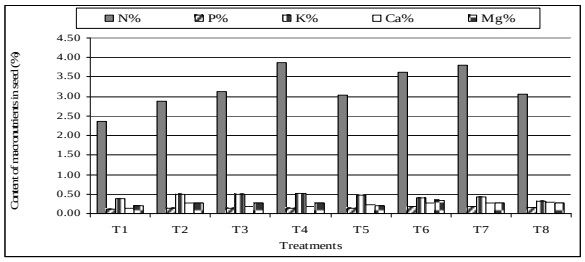

Figure 1. Effect of foliar application with urea and potassium dihydrogen orthophosphate on content of macronutrients content in seed (%)

Spraying faba bean plants with 5g/L potassium dihydrogen orthophosphate (PDO) gave the highest concentrations of potassium in seeds compared to control. Potassium concentration in seeds ranged between 0.51 to 0.32%. The lowest Potassium concentration (0.32%) was recorded when spraying faba bean plants with (5g/L U + 10g/L PDO). Such enhancement effect of nitrogen, phosphorus and potassium might be attributed to the favorable effects of these nutrients on metabolism and biological activity and its stimulating effect on photosynthetic pigments and enzyme activity which in turn encourage vegetative growth and yield of plants and consequently mineral nutrients content in seed Michail *et al.,* (2004) The effect of foliar application was more important than soil application because foliar application enhanced the uptake of NPK from the soil by the plant according to Satyanarayanamma *et al.*. (1996). The results showed that the maximum calcium concentration in faba bean seeds was observed when the plants were sprayed with (5g/L U+ 10g/L PDO).

Figure 2 show that spraying faba bean plants with 5g/L U gave the highest value of Fe concentration in seed (ppm) followed by plants treated with (5g/L U + 5g/L PDO). Zinc concentrations in seeds ranged between 43-66 ppm with different treatments. The maximum value of zinc (66 ppm) was observed in seeds with spraying faba bean plants of (5g/L U + 5g/L PDO). Faba bean spraying with (5g/L U + 5g/L PDO) gave the highest concentration of manganese in seeds compared with other treatments, while spraying the plants with (5g/L U + 2.5g/L PDO) gave the lowest of cupper concentrations in seeds plants (4ppm).

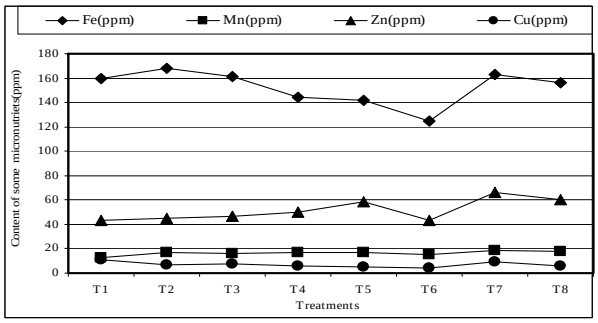

Figure 2. Effect of foliar application of urea and potassium dihydrogen orthophosphate (PDO) on content of some micronutrients in seed (ppm)

Conclusion: It could be concluded from this study that foliar application of urea and potassium dihydrogen orthophosphate increasing yield and improving quality of faba bean seeds under sandy soil of AL-Behara Governorate, Egypt.

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