Assessment of Some Qualitative and Essence Percentage Traits in (*Trigonella foenum-graecum* L.) Under Urea Foliar Application and Irrigation with Purified Domestic Wastewater

Maede Modanlo[1]

1 Department of Agronomy,Shahr-e-Qods Branch,Islamic Azad University,Tehran,Iran

Abstract

To evaluate the effect of irrigation with purified domestic wastewater and foliar application of urea on some qualitative and essence percentage traits of fenugreek, an experiment was conducted in factorial experiment based on completely randomized block design with three replication. Factors of the experiment were the purified domestic wastewater (0, 50 and 100 mg/l) and the foliar application of urea (0, 3 and 6 percent). The evaluated characteristics were: essence yield, essence percentage, nitrogen uptake percentage, phosphorus uptake percentage, potassium uptake percentage and protein percentage in shoots of fenugreek. The results displayed significant differences ($p<0.01$) between all of the measured traits in different levels of foliar application of urea and wastewater application and their interactions. The highest and lowest essence yield (12.59 kg/ha) and essence percentage (0.49) were obtained in 6 % urea and no consumption of urea. The most essence yield (12.54 kg/ha) and essence percentage (0.52) were observed in 100 mg/l purified domestic wastewater. Application of 100 mg/l purified domestic wastewater plus 6 % urea had the most essence yield (13.38 kg/ha) and essence percentage (0.53), also the control showed the least average of traits.

Keywords: wastewater, urea foliar application, essence percentage.

Introduction

Fenugreek (*Trigonella foenum* L.), an angiosperm plant, is belonging to Fabaceae family. This plant is native to Iran and later transferred to other areas of the world (Dini, 2006; Mozafarian, 1995). The main chemical constituents of fenugreek are saponins, alkaloids and mucilage fibers (50 %). fenugreek has a wide range of therapeutic effects. For example, studies are demonstrating that fenugreek seeds are using to reduce blood sugar levels in type II diabetic patients (with insulin independent). It is also use to reduce the cholesterol and triglyceride levels, treating gastritis, headache, flatulence, osteoporosis, cancer, anemia and pulmonary infections (Sharma and Raghram, 2000). Fenugreek seeds are used as spices in food preparations to improve or impart flavor and are good sources of protein, fat, minerals, and dietary fiber. The main chemical constituents of fenugreek are proteins rich in lysine and tryptophan, flavonoids (e.g. quercetin, trigonelline, saponins, and phytic acid), and polyphenols (Kochhar *et al.* 2006).

Since, the use of low-input farming systems has found a considerable position in order to invent modern methods to management of resource utilization, and achieve the goals of sustainable agriculture, So that, management of production systems plays a more important role. Foliar application is one of these strategies, so that, studies showed that using urea as foliar application on green organs of the plant, causing the further production quantity of essential oil of fennel compared to the direct use in the soil. The constituents of the essence of the plant was also influenced by fertilization method. Foliar application, also, preserve the health of the environment, particularly soil resources (khan *et al.*, 1992).

Material and Method

The Present study was undertaken at Islamic Azad University, Shahr-e-Qods Branch of Tehran (20 km Tehran-Karaj old road; 27° 38′ N and 40° 21′ W with an altitude of 1417 m) in 2011. The climate of the experiment location is arid and semi-arid with an average annual precipitation of 180 mm. Cultivated area was approximately 1.5 hectares. In a part of the farm, a piece of land with an area of 250 m² was determined and it surface was flat with a roller. Thereafter, the conditions and the gradient topography of the land was prepared for the implementation of a lysimeter network. A management design lysimeters were used to application of the refined raw domestic wastewater for irrigation of the fenugreek medicinal plant. The experiment was carried out as a factorial experiment based on RCBD with three replications. The experimental factors were urea foliar application (N) with three levels (0, 3 and 6 %) and purified domestic wastewater with three levels (0, 50 and 100 mg/l). For this purposes, 27 cylindrical lysimeters made of hard polyethylene plastic were used in 60 cm diameter and height of 100 cm was used. To remove excess water (drainage water) from lysimeters, perforated pipes were considered in the bottom of the lysimeters. Thus, a hole with a diameter of 4 cm was placed at the bottom of the lysimeter. Then a flexible pipe that was fastened with glue aquarium to the bottom of lysimeters were used as drainage pipes. Afterward, to prevent effect of the soil moisture on the in the experiment, barrels placed on metal legs (40 cm in height). In addition, the distance between lysimeters was 2 mm to going easier between them. After installation of lysimeter, they were filled to a height of 85 cm with the soil that taken from 30 cm depth of cultivated land. After the adding the soil into the lysimeters, we let them four days so that soil settlement does not an error in the experiment. The sand (a thickness of 1 cm) was used to prevent crusting of the soil surface in the lysimeters. Foliar applications of urea was performed in the three growth stage of the plant including eight-leaf stage, the beginning of stem elongation and beginning of the flowering. Weed control were done manually. Irrigation with domestic wastewater was performed, once a week. To evaluation of qualitative and essence percentage traits in *Trigonella Foenum* such essence yield, essence percentage, nitrogen uptake percentage, phosphorus uptake percentage, potassium uptake percentage and protein percentage in shoots of fenugreek, 100 grams (per replications of the same lysimeters) was harvested in the physiological maturity stage in each lysimeter.

Statistical analysis

Statistical analysis were carried out using SPSS software. Mean separation was performed using Duncan's Multiple Range test at 0.05 probability level after ANOVA.

Results and Discussion

The results of this study showed the significant effects ($p<0.01$) of urea foliar application, irrigation with wastewater and their interactions effects on essence yield, essence percentage, nitrogen uptake percentage, phosphorus uptake percentage, potassium uptake percentage and protein percentage in shoots of fenugreek (Table 2).

Essence yield

Significant difference was observed between urea levels, different levels of wastewater and also between their interactions for essence yield (Table 2). Increasing in the wastewater, increase the flowering shoot yield in the fenugreek. The maximum essence yield was obtained in the N3W3 treatment and the lowest observed in the N1W1 treatment (Table 3), thus essence yield rose with increase in urea and wastewater. Since the essence yield depends on essence percentage and biological yield especially the amount of leaves, therefore, any reduction in essence percentage and biological yield will lead to reduction in essence yield. Former studies indicated that using of aerial spraying of nitrogen significantly increased the percentage and yield of essence in fenugreek compared to control.

Essence percentage

In this study, significant difference was observed between urea levels, different levels of wastewater and also between their interactions for essence percentage (Table 2). Increasing in the urea levels and wastewater, increase the essence percentage in the fenugreek. As shown in the table 3, the greatest essence percentage was obtained in the N3W3 treatment (0.06 % urea plus 100 mg/l wastewater) with an average of 0.53 and the smallest amount (0.44) observed in the N1W2 (100 mg/l wastewater without urea application and control. This indicate that regarding to application do urea, non-use of wastewater caused reduction in production of essence (Figure 2). The results indicated positive effect of the urea application and wastewater at third level.

Nitrogen uptake percentage

The results showed that there were significant differences between urea levels, different levels of wastewater and also between their interactions for nitrogen (N) uptake percentage (Table 2). The most N uptake was obtained in the N3W3 treatment (6.07) and the smallest amounts (5.39) observed in the N1W1 and N1W2 (table 3). Application of urea and wastewater increased the N uptake in the fenugreek shoots (Figure 3). This suggests that the nutrients containing in wastewater such as nitrogen, phosphorus and potassium can be a good alternative to chemical fertilizers and will also save on costs. So, it looks that urea foliar application is required in this situation. Former studies have indicated that due to having different forms of nitrogen in wastewater, specific organic compounds of this element, can have an important role in plant nitrogen supply (Ayers and Westcot 1985). The gradual release of N in wastewater can reduce loss of nitrogen in different forms and this makes it more important using treated wastewater in agriculture.

Phosphorus uptake percentage

The results showed that there were significant differences between urea levels, different levels of wastewater and also between their interactions for phosphorus (P) uptake percentage in the fenugreek shoots (Table 2). The maximum phosphorus uptake in the fenugreek shoots was observed in the N1W3 treatment (0.35) and the smallest amount (0.15) observed in the N2W1 (table 2). Therefore, using wastewater solely could increase the phosphorus uptake in the fenugreek shoots (Figure 4).

Potassium uptake percentage

Significant difference ($p<0.01$) was observed between urea levels, different levels of wastewater and also between their interactions for potassium uptake percentage (Table 2). The most potassium uptake percentage was observed in the N3W3 and N1W3 treatments and the lowest was observed in the control treatment (Table 3). The potassium uptake percentage was approximately equal in the N2W1 and N2W2 treatments. Thus, application or not use of wastewater (50 mg/l) in the 0.03 % urea had no effect on the potassium uptake percentage in fenugreek shoots (Figure 5).

Protein percentage

Results illustrated that there were significant differences ($p<0.01$) between urea levels, different levels of wastewater and also between their interactions for protein percentage in the fenugreek shoots (Table 2). The highest and lowest protein percentage in the fenugreek shoots obtained in N1W3 (16.17) and N2W1 (11.85), respectively. This indicated that increasing 100 mg/l wastewater solely, caused the most protein accumulation in the shoots. Application of wastewater spite of the lack of urea consumption, had the lowest protein in the shoots. This show the significant role of substances in the wastewater in increasing amount of protein in the fenugreek shoots. Since, the protein percentage was same in N2W2 and N2W3 treatments, therefore, increasing the wastewater (50 mg/l) in the 0.03 % urea had no effect on the protein percentage in fenugreek shoots (Figure 6).

The correlation coefficients have been investigated in this study in available in table 4. As the table shows, there were a significant positive correlation ($p<0.01$) between all of the characters.

Conclusion

Essence yield, essence percentage reached the maximum, using the wastewater combined with urea application. The least essence yield, essence percentage observed in control treatment that display the useful effect of wastewater combined with urea application in fenugreek.

References

1. **Ayers, R. S. and D. E. W. Westcot**. 1985. Water Quality for Agriculture. 29 Rev. 1, FAO, Rome.
2. **Dini M**, 2006. Scientific name of medicinal plants used in traditional medicine, Forest and Rangeland Research Institute Publication, Iran, 2006, pp: 299– 300.
3. **Khan, M. M. A., Afag, S. and Afidi, M. M. R. K**. 1992. Yield and quality of fennel (*Foeniculum vulgare .Mill*) in relation to base and Foilar application to nitrogen and phosphorus. Journal of Plant Nutrition, 15 (11): 2502 - 2515.
4. **Kochhar A, Nagi M, Sachdeva R.** Proximate composition, available carbohydrates, dietary fibre and anti-nutritional factors of selected traditional medicinal plants. J Hum Ecol. 2006; 19: 195-9.
5. **Mozafarian V.** 1995. Plants Names Dictionary of Iran. Farhang Moaser Publication, Iran, 1995, 558 p.
6. **Sharma RD, Raghram TC**. 2000. Effect of fenugreek seeds on blood glucose and serum lipids in type I diabetes. *Eur. J. Clin nutr*, 44: 301-6.

Table 1. Domestic waste water characteristics

Parameters	Unit	Concentration
COD	mg/L	۲۳۲
BOD5	mg/L	۱۵۰
EC	ds/m	۱/۸۳
PH	-	۷/۹
N	mg/L	۳۲/۱۱
P	mg/L	۳/۴۱
K	mg/L	۱۲/۱۸
Total Organic C	mg/L	۱۵۰/۴۷
Ni	mg/L	۱/۸۳
Cd	mg/L	۰/۰۴
SAR	-	۱/۰۱
Na	meq/L	۱۳/۸۲
Ca	meq/L	۳/۵۱
Mg	meq/L	۲/۷۱
Sulfate	meq/L	۳/۴۲
Bicarbonate	meq/L	۱۱/۱۸
Cl	meq/L	۸/۲
Fe	mg/L	۱/۵۱
Pb	mg/L	۰
Ni	mg/L	۰/۲۰
Cr	mg/L	۰
Sn	mg/L	۰/۰۰۲
Co	mg/L	۰
Coliform bacteria faecal	Numbers per 100 ml	۱/۲×۱۰^۱۸
Parasite eggs	Numbers in 1 Liter	<۱

Table 2. Analysis of variance for some characteristics in dill

		MS					
SOV	df	Essence yield	percentage of Essence	absorption-N	absorption-p	absorption-k	pr-percentage
Replication	۲	۰/۰۰۷*	۰/۰۰۰*	۰/۰۰۰ns	۰/۰۰۰ns	۰/۰۱۰*	۰/۱۰۲ns
Foliar-N	۲	۳/۵۸۰**	۰/۰۰۱**	۰/۱۲۴**	۰/۰۰۵**	۲/۱۶۸**	۴//۸۱۳**
Wastewater	۲	۳/۸۳۰**	۰/۰۱۴**	۰/۴۵۲**	۰/۰۲۶**	۵/۴۴۳**	۱۷/۰۷۷**
N*W	۴	۰/۰۲۲**	۰/۰۰۰**	۰/۰۰۷**	۰/۰۰۵**	۱/۸۹۷**	۱/۸۲۹**
Error	۱۶	۰/۰۰۱	۰/۰۰۵	۰/۰۰۱	۰/۰۰۵	۰/۰۰۲	۰/۰۳۴
C.V %	-	۶/۳۸	۷/۳۷	۳/۷۷	۲۵/۴۵	۲۶/۷۹	۱۰/۴۲

ns, * and **: non-significant, significant at 5% and 1% levels of probability, respectively.

Table 3. Mean comparison of determined characteristics for wastewater and N-foliar

	Essence yield	percentage of Essence	absorption-N	absorption-p	absorption-k	pr-percentage
foliar-N						

N_1		۱۱/۴۵ j	۰/۴۷ g	۵/۵۹ f	۰/۲۴ c	۳/۸۷ d	۱۴/۱۵ d
N_2		۱۱/۵۵ i	۰/۴۸ f	۵/۶۱ ef	۰/۲۰ i	۲/۹۴ i	۱۲/۷۳ h
N_3		۱۲/۵۹ b	۰/۴۹ e	۵/۸۰ c	۰/۲۱ gh	۳/۶۷ e	۱۳/۷۵ e
wastewater							
W_1		۱۱/۲۴ k	۰/۴۴ i	۵/۴۴ h	۰/۱۷ k	۲/۸۴ jk	۱۲/۲۸ i
W_2		۱۱/۸۱ h	۰/۴۷ fg	۵/۶۸ d	۰/۲۱ gh	۳/۲۹ g	۱۳/۳۵ fg
W_3		۱۲/۵۴ b	۰/۵۲ b	۵/۸۸ b	۰/۲۷ b	۴/۳۶ b	۱۵/۰۱ c
N*W							
	W_1	۱۵/۶۷ b	۱۰/۸۳ m	۰/۴۴ j	۵/۳۹ h	۰/۱۷ k	۲/۷۶ k
N_1	W_2	۱۱/۴۵ J	۰/۴۵ h	۵/۵۹ f	۰/۲۱ h	۳/۱۳ h	۱۲/۸۳ h
	W_3	۱۲/۰۸ e	۰/۵۱ bc	۵/۷۹ c	۰/۳۵ a	۵/۷۲ a	۱۳/۴۶ efg
	W_1	۱۰/۹۵ l	۰/۴۵ h	۵/۳۹ h	۰/۱۵ l	۲/۸۵ jk	۱۶/۱۷ a
N_2	W_2	۱۱/۵۴ I	۰/۴۷ f	۵/۶۵ de	۰/۲۱ fgh	۲/۸۱ k	۱۱/۸۵ j
	W_3	۱۲/۱۸ d	۰/۵۱ c	۵/۷۹ c	۰/۲۳ d	۳/۱۷ h	۱۳/۱۶ g
	W_1	۱۱/۹۵ f	۰/۴۴ j	۵/۵۲ g	۰/۱۸ j	۲/۹۲ Ij	۱۳/۱۹ g
N_3	W_2	۱۲/۴۵ c	۰/۴۹ d	۵/۸۱ c	۰/۲۱ fgh	۳/۹۳ d	۱۲/۱۵ ij
	W_3	۱۳/۳۸ a	۰/۵۳ a	۶/۰۷ a	۰/۲۴ d	۴/۱۸ c	۱۳/۴۴ efg

Similar Letters in – in each column shows non – significant difference according to Duncan's multiple range test at 5% level of probability

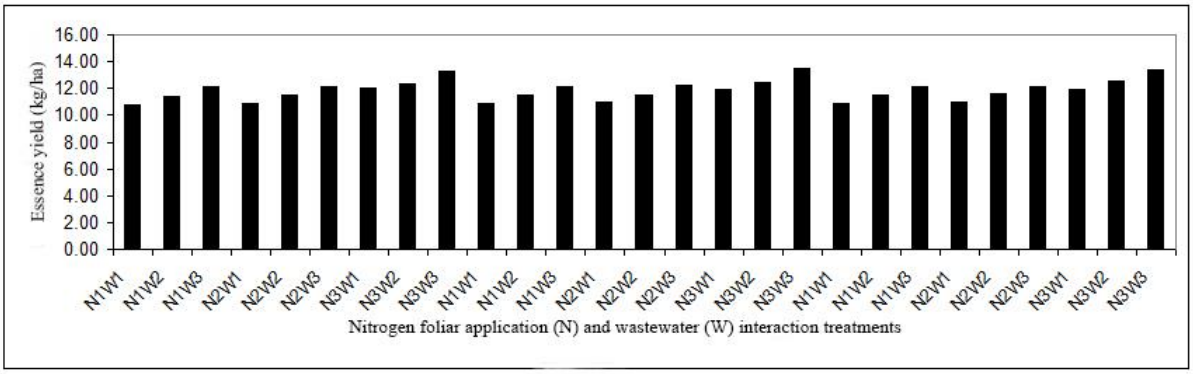

Fig 1. - Effect of wastewater and N- foliar Essence yield

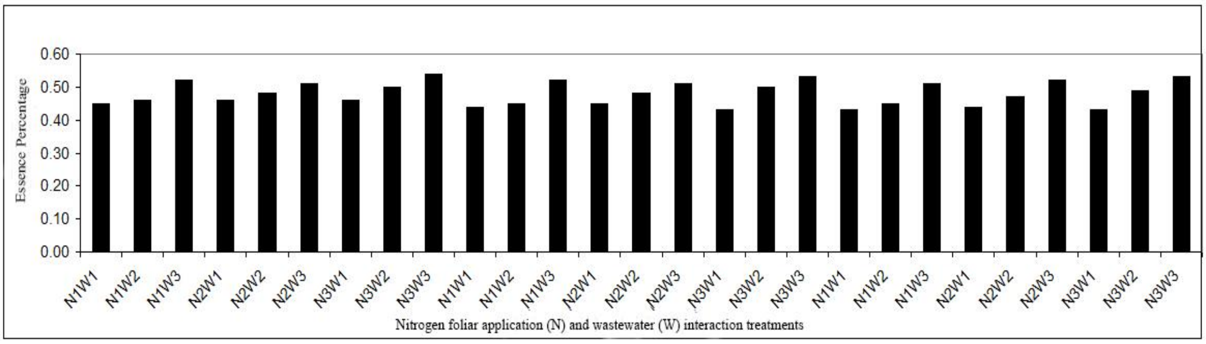

Fig 2. Effect of wastewater and N- foliar on percentage of Essence

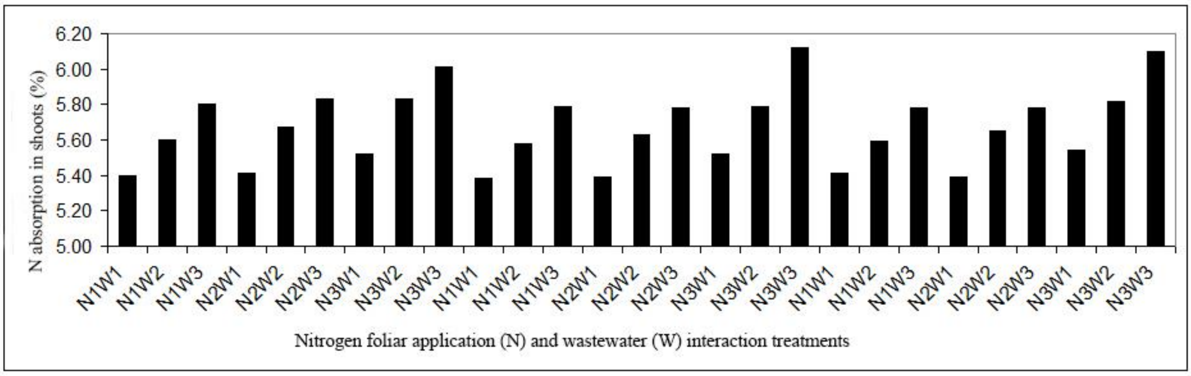

Fig 3. Effect of wastewater and N- foliar on absorption Nitrogen

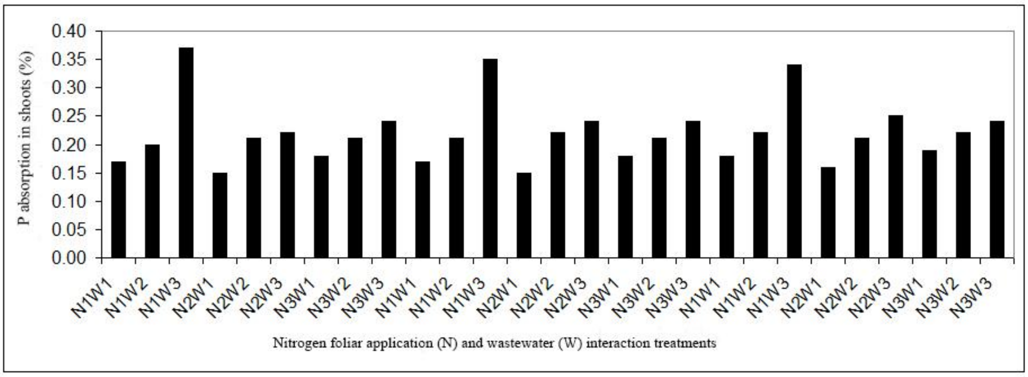

Fig 4. Effect of wastewater and N- foliar on absorption phosphor

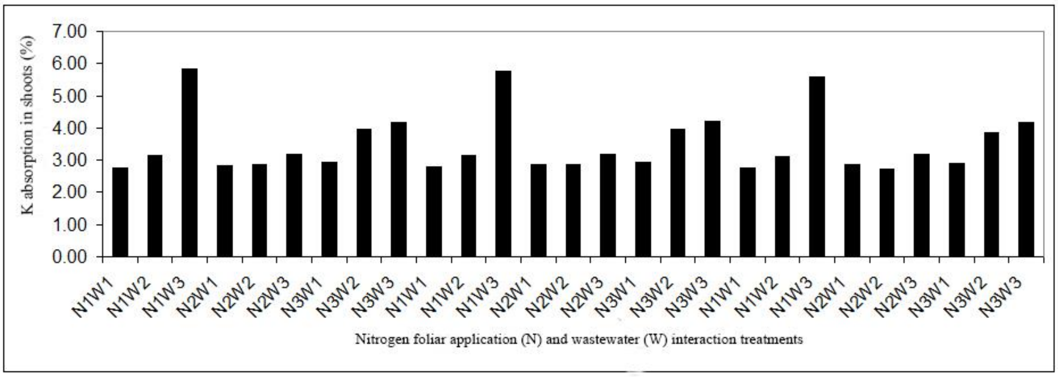

Fig 5- Effect of wastewater and N- foliar on absorption potassium

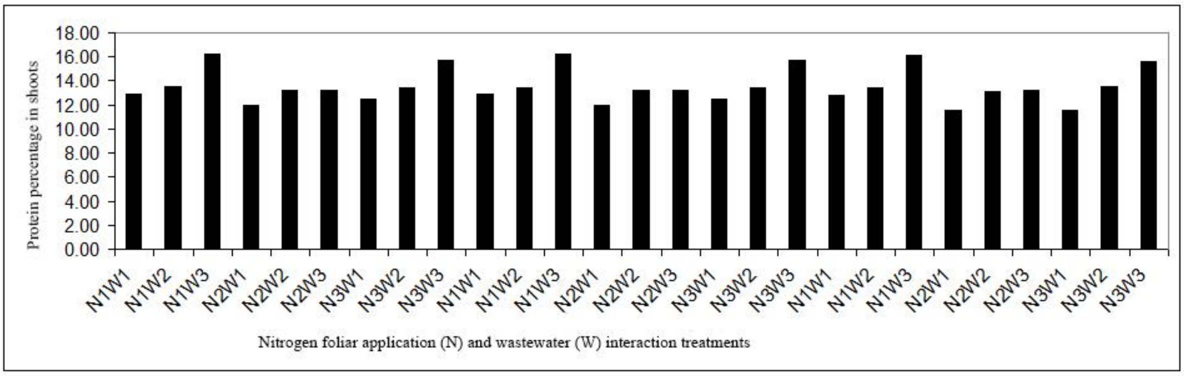

Fig 6- Effect of wastewater and N- foliar on absorption protein

Table 4- Correlation coefficients for experimental characters

	Essence yield	Essence percentage	N uptake percentage	P uptake percentage	Potassium percentage	Protein
Essence yield	1					
Essence percentage	.797(**)	1				
N uptake percentage	.944(**)	.906(**)	1			
P uptake percentage	.472(*)	.697(**)	.600(**)	1		
Potassium percentage	.542(**)	.691(**)	.615(**)	.901(**)	1	
Protein	.640(**)	.786(**)	.760(**)	.855(**)	.880(**)	1

Ns, * and **: Correlation is no-significant, significant at the 0.05 and 0.01 level (2-tailed)