The Effect of Nitrogen Fertilizers (Urea, Sulfur Coated Urea) with Manure on the Saffron Yield

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Keywords: saffron fertilization, saffron nitrogen nutrition, S.C.U.

Abstract:

This research in saffron plant nutrition was done in three areas belonging to Khorasan province (Iran), one in Gonabad region, and other two (Boroon and Eslamieh) in Ferdows region. The experiment was carried out as a Randomized Complete Block Design (RCBD) in five farms of each region, with the sum of fifteen different farms. There were nine treatments with three replications in each farm. They consisted in one control using only (30 Ton/ha) manure as fertilizer, together with other treatments using different rates of (23, 34, 46, 57) Kg/ha pure Nitrogen (N) from two different sources of Urea and Sulfur Coated Urea (S.C.U.), plus the 30 Ton/ha manure as the fertilizer needed for each experiment. Relative Yield was calculated as:

Relative Yield (%) = (Treatment Yield in each Expt.*100 / MAX. Yield in the same Expt.)

Analysis System package (SAS), in the Eslamieh area of Ferdows region and in Gonabad region, the effect of N fertilizer type on the relative yield of saffron was non-significant. For the N-fertilizer rate there was a significant difference at (α = 0.01 %). However, in the Boroon area of Ferdows region, none of the factors had a significant effect on the saffron yield. Maximum yield obtained in each of the areas of Eslamieh, Gonabad and Boroon were in the order of (7.1, 6.5, 7.01) Kg/ha respectively. Based on the Duncan's Multiple Range Test (DMRT) mean comparison analysis at (α = 0.05 %), for simple and interaction effects of the type and rate of N fertilizer for the Eslamieh area, there was no significant effect for the type, but there was a significant difference on the different rates, such that the maximum yield was obtained from the 3rd N rate. It seems that the saffron response to the N-fertilizer is based on the characteristics of the different areas. Meanwhile, if %O.C. and NO3-N of soils are low, 46 Kg/ha of pure N from both (Urea, and S.C.U.) sources plus the (30 Ton/ha) manure can be used, and an increase in saffron yield is expected. Nitrogen amounts higher than (57 Ton/ha), if not reducing the yield, will not increase it significantly. Investigating the effect of higher rates of N above (57 Kg/ha), and also the application time and type of N fertilizer, could be good topics for future research.

INTRODUCTION

In the arid and semi-arid areas of Khorasan, the low organic matter in the soils, nitrogen (N), is the most limiting factor for plant growth. Not considering solely the role of N as building block of chlorophyll, other different key functions have been ascertain such as its role as building block of nucleic acids, amino acids, poly amines, and phospholipids. This caused that some people consider N as crucial for plant growth, and some others compare it as the role of gasoline for the automobile. In relation to the research done with saffron, Sadeghi et al. (1987) suggested that if soil phosphorous (P) level is about 10 mg/Kg, absorbed potassium (K) level would about 200 mg/Kg and % O.C. about 1%. Therefore, to reach the optimum level for N. P. K nutrients, application of only N fertilizer would be enough. Also, Sadeghi et al. (1988) suggested that using 100-110 Kg/ha urea on a yearly basis produce the best results. The effect of N on the saffron

quality, and especially in coloring properties, is well documented (Dutta Biswas et al., 1956; Sampathu et al., 1984; Munshi et al., 1989). Unfortunately, there has been too little research on saffron plant nutrition physiology and, therefore, the production methods need changes from customary practices to more advance scientific methods, in order to ascertain the exact amount of nutritional elements required for this crop.

MATERIALS AND METHODS

This work was carried out in three areas, Ghonabad, Boroon, and Eslamieh, separately. This experiment was conducted as a randomized complete block design in five farms of each region, with nine treatments and three replications. The experimental treatments included, one control (using 30 Ton/ha of animal manure), and different rates (23, 34, 46, and 57) Kg/ha of pure N as the fertilizer form, from the two sources of Urea and S.C.U plus the 30 Ton/ha of animal manure. The mean soil physical and chemical characteristics of this experiment in the three regions are shown in table 1. The Percent Relative Yield (% R.Y) in each treatment was calculated as shown below, and data was analyzed statistically by Statistical Analysis System Package (SAS, 1985).

% R.Y = (Treatment yield in each farm / Maximum yield in the same farm)* 100

Plant Material

The plants used in these experiments were saffron crocus (*Crocus sativus* L.) from the southern part of Khorasan, Iran.

Treatments

In these experiments, treatments were done in a RCBD design in five farms of each region, with the sum of fifteen different farms. There were nine treatments with three replications in each farm. The treatments included were: One control using only (30 Ton/ha) manure as fertilizer, and the other treatments were different rates of (23, 34, 46, 57) Kg/ha pure Nitrogen (N), from two different sources of Urea and Sulfur Coated Urea (S.C.U.), plus 30 Ton/ha manure as fertilizer needed for each experiment.

RESULTS AND DISCUSSION

Based on the analytical results of variations in data in Eslamieh area of Ferdows region and Ghonabad region, the type of N fertilizer effect on the relative yield of saffron was non-significant, and the N rate used at α= 0.01 probability level was significant. Meanwhile, in Boroon area of Ferdows none type and rate of fertilizers had a significant difference on saffron relative yield. Maximum mean yield in each of the different areas, Eslamieh and Boroon in Ferdows region, and Ghonabad region, were in the order of 7.1, 7.01, and 6.5 Kg/ha. Based on the Duncan's Multiple Range Test (DMRT) results (α= 0.05) for comparison of simple and interaction effects on the type and rate of N fertilizer in Eslamieh area, there was no significant differences between the different rates, but the maximum relative yield was obtained from the third rate of N fertilizer. Mean comparison tests of the interaction effects between the type and rate of N fertilizer (Figure 1) showed that for the Eslamieh area, at each of the N fertilizer types, the relative yield increased at first and then decreased by increasing used amount of each of the N fertilizer types, and maximum relative yield was obtained from the third rate of two N fertilizer types. Relative yield in low amounts of N fertilizer for S.C.U. was more than Urea, and in high amounts of N rates was converse. Although, the lowest relative yield was obtained at the first rate of N fertilizer and by increasing the rate, the relative yield was also increased.

Fertilizer in Boroon area (Fig 2) showed that in relation to S.C.U., the increasing mean comparison tests for the interaction effects on type and rate of N relative yield was obtained in the third rate of N fertilizer. Although the relative yield in fertilizer rates of (1, 3, 4) were in one group, and were significantly lower in relation to the second rate of N fertilizer, and with the Urea type of fertilizer above the second rate, increasing relative yield was obtained. Meanwhile there were no significant differences between the two fertilizer rates (3 and 4). In the Eslamieh area of Ferdows relatively, the higher amount of

S.C.U. was obtained at the low level of fertilizer use, and the higher Urea amount was obtained at the high level of fertilizer used. Even though, these differences were non-significant, but it seems that we can relate it to the higher drainage amount of Urea in comparison to S.C.U. In such a way, since the drainage amount of water is higher in urea in comparison to S.C.U. at the low level of N fertilizer, the remaining N available at the root is not enough for the optimum yield. Although the S.C.U can slowly release the N needed for the plant, therefore the drainage losses will decrease, and the optimum growth and yield will be obtained. Also at high rates of N, knowing the N disadvantages yields were decreased by the use of S.C.U. (Figures 1-3). But with urea treatments, since there are higher drainage losses than S.C.U., the effects of higher N amounts used were lower, and except for Eslamieh region, there were significant increases in the other two areas.

Disadvantages of increasing use of N fertilizer, e.g. poor root development and underground parts of the plant, the flowering effect, and freezing injury, have been demonstrated in other crops (Sadeghi et al., 1987). Nevertheless, in various experiments carried out with these two types of fertilizers, similar and contradictive results have been reported (Marschner, 1995; Munshi et al., 1989; Office of Information and Statistics, 1999). Based on the DMRT test results in Boroon area of Ferdows region, there were no significant differences between type and different rates of N fertilizer for the simple effects. Moreover, for the mean comparison tests of the interaction effects on type and rates of N fertilizer, there were no significant differences between the rates of N fertilizer in this area (Figure 2).

Based on the experimental results, it seems that the saffron response to the N fertilizer use is different depending on the different areas. Even though, the soil O.C. % and NO3 level are low in the three regions, we can use 46 Kg/ha of pure N from each of the two sources with the 30 Ton/ha of animal manure, and still expect the increase in yield compared to the use of animal manure alone. At the higher N rates up to 57 Kg/ha, there will be no increasing significant effect, if it doesn't cause a significant decrease in yield.

Investigating the effects of higher N rates above 57 Kg/ha, and also the time and method of N fertilizer application, should be an important subject for future research.

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Tables

Table 1. Mean soil physical and chemical characteristics of the three regions.

Region	PH	Ec (ds/m)	%N	%O.C	P	K	No3	% T.N.V	% San	% Silt	% Clay	SAR
Boroon	8	5.9	0.024	0.348	12.18	275	14.5	11.1	55	28.4	16.4	15.98
Ghonabad	7.9	5	0.026	0.326	7.78	224	14.9	15.3	58.4	26.8	14.8	5.12
Eslamieh	7.9	3.7	0.034	0.566	16.86	337	11	17.1	51.8	30.2	18	11.82

Figures

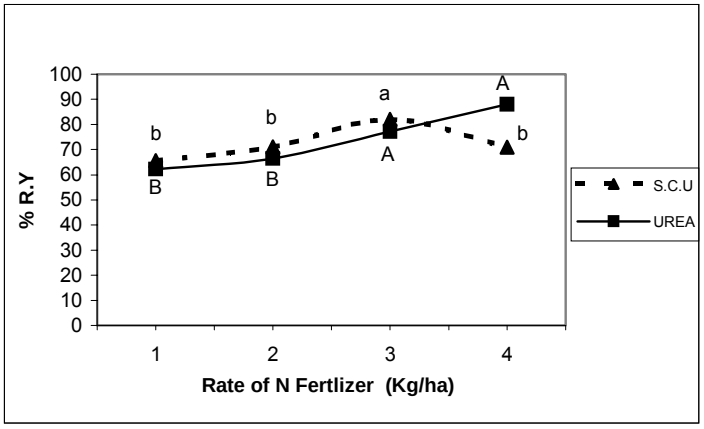

Fig. 1. The effect of type and rate of N fertilizer on % R.Y in Ghonabad region

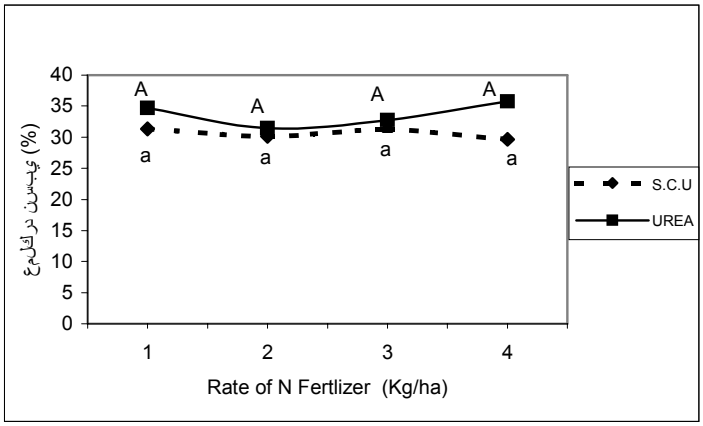

Fig. 2. The effect of type and rate of N fertilizer on % R.Y in Boroon region

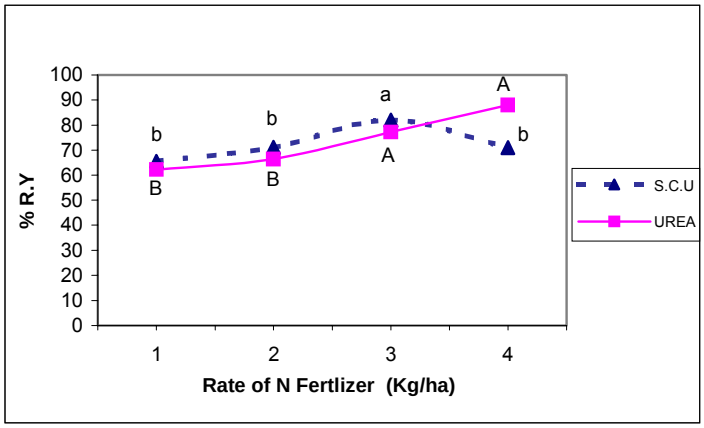

Fig. 3. The effect of type and rate of N fertilizer on % R.Y in Ghonabad region