Various quantitative regimes of NPK influence the growth and quality of saffron (*Crocus sativus* L.)

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ABSTRACT

Saffron (*Crocus sativus* L.) is amongst the world's most expensive aromatic and medicinal plant, being sensitive and difficult to produce in higher quantities. It has attractive flowers having different colors and varying sizes. Being a potential medicinal crop it has great demand globally but inexpedient cultural practices are some of the bottlenecks in its production. Therefore, a study was conducted to evaluate the influence of different levels of NPK for the growth and quality of saffron. The experiment was executed in shadehouse, Floriculture Research Area, Institute of Horticultural Sciences, University of Agriculture, Faisalabad. Soil based application of NPK in three splits was done, one at planting time and other after 25 and 60 days of sowing. Experiment was laid out according to Randomized Complete Block Design with five treatments, replicated thrice. Varying levels of NPK produce significant effect on number of leaves per plant, number of flowers per plant, flower fresh weight (g), flower dry weight (g) and flower size (cm) etc. Data regarding growth, flowering and corm indices were collected and analyzed statistically according to Fisher's analysis of variance technique and treatments were computed according to LSD test at 5% level of probability.
Key words: Saffron, NPK, Quality, growth.

INTRODUCTION:

Saffron (*Crocus sativus* L.) is a sterile triploid plant from iridaceae family. Among the 85 species belonging to the genus Crocus, C. sativus L. (Saffron) is amongst most captivating and valuable plant specie propagated through corms because of sterile flowers that are fail to produce viable seeds (Fernández, 2004). Dried stigmas of this flower yields a high valued spice that has been consumed since ages for its aromatic and highly medicinal characteristics (Plessner et al., 1990). The paleohistory of this plant indicates its domestication dates back to 2,000-1,500 years ago BC (Grilli Caiola, 2004). It was sold between 200 and 1600 USD/kg in the world markets depending on quality (Garcia, 1997). Greece, Spain, Morocco, Iran and India are the major saffron producing countries while, Italy, Switzerland, Argentina, Turkey, Azerbaijan and Austuralia contribute remarkable share in its production, which is about 205 tons annually (Fernandez, 2004). Commercial cultivation of saffron in Pakistan is confined to the areas of "Gilgit-Baltistan" and "Azad Kashmir" where, this profitable crop is produced in lesser quantities and remained neglected in the past (Vurdu et al., 1997).

Saffron has been used since the ancient times for different purposes such as medicinal, aromatic, food ingredient, textile dyeing, etc. Dried stigmata of saffron were used to give flavor to some meals. The plant produces several secondary metabolites such as safranal, crocin, and crococetin (Negbi et al., 1989). It is a sterile triploid and does not set viable seeds. Thus, it is propagated vegetatively by its corms (Behnia et al, 1997). In our areas soil fertility levels are different and application of chemical fertilizers are useful for plants. To sustain quality characters, good management practices careful application of chemical fertilizer is required. The proper NPK ratio is necessary for crop success and to improve yield. Fertilizers not only help to raise the production of flowers by maintaining the growth and vigor, but also protect them from damage of insects, pests and diseases (Larson, 1980).

Studies to increase yield and quality of saffron have focused on different cultivation methods (planting, fertilization, irrigation, growing media, etc.) (Behnia et al., 1997). An ealier study showed that NPK application contributes to fresh flower yield of saffron (Unal and Cavusoglu, 2005). Behzad et al. (1992) stated that NPK fertilizer and cow manure applications elevated fertility of soils in saffron cultivation. Generally high use of Nitrogen and lesser usage of Potassium increase the vegetative growth, on the other hand lesser amount of Nitrogen with high dose of Potassium enhance flowering (Mengel and Kirkby, 1978). By increasing the level of NPK flowering time, corm size, corm weight and number of cormels per plant in saffron are increased (Bhattacharjee, 1981). Koocheki et al. (2006) found that 20 to 80% of saffron yield is attributed to soil fertility (C/N ratio, available phosphorus, mineral nitrogen, and exchangeable potassium). Another study showed that nitrogen application contributes to fresh flower yield of saffron.

MATERIAL AND METHODS

The present research experiment was conducted in greenhouse, at rose project Institute of Horticultural Sciences, University of Agriculture, Faisalabad, from 20th November 2015 to the end of February 2016. After selection of site, Soil was properly prepared, mixed and leveled. Experimental area was divided into blocks, according to randomized complete block design. A basal dose of NPK (17:17:17) at 100 kg/acre was applied equally to all blocks. The planting material (corms) were obtained from Green Impex Pvt. Ltd. Islamabad, an importer of flower Bulb Company of Holland in Pakistan. Corms were sown in November and harvested in February. So, the duration of crop was 3-4 months. Before plantation of corms, land was prepared properly. The planting was done at distance of half feet distance from plant to plant and one foot from row to row.

Experiment was comprised of five treatments including control. Each treatment was replicated thrice and 10 plants included in each treatment. Half dose of (NPK 17:17:17) was applied after 25 days of sowing and remaining half after 60 days of sowing. Varying levels of NPK were applied like Control (T_0), 15 g/m^2 (T_1), 30 g/m^2 (T_2), 45g/m^2 (T_3), and 60 g/m^2 (T_4). Plants were irrigated according to field capacity during period of the experiments. Data was recorded at harvest on growth and quality parameters included plant height (cm), number of leaves/ plant, Flower size (cm), leaf length (cm), Fresh flower weight (g), days to sprouting, sprouting percentage (%), corm size (cm), corm weight (g) There were no harmful attack of diseases and insect pest.

Plants were allowed to grow and data regarding following parameters were collected using standard procedures. Data collected will be analyzed statistically using Fisher' analysis of variance (ANOVA) techniques (Steel et al., 1997). The means values will be compared with least significance difference test (LSD) following (Snedecor and Cochran, 1980).

RESULTS AND DISCUSSION

Sprouting percentage (%)

Sprouting percentage in saffron was influenced by the application of varying levels of NPK. The data (Fig I) showed that maximum sprouting percentage (94.98 %) was recorded in T_3 (NPK 45g /m^2), whereas the minimum sprouting percentage (74.33 %) was observed with T_0 (control). T_1 (NPK 15 g/m²), T_2 (NPK 30 g/m^2) and T_4 (NPK 60 g/m²) having sprouting percentage (80.667, 88.96 and 88.06 % respectively). So, it was concluded that for improvement in sprouting percentage and other growth and quality parameters were observed when appropriate amount of fertilizers were added. These results also supported by Miroslava (1962).

Leaf length (cm)

Leaf length in saffron was influenced by the application of varying levels of NPK. The data (Fig 2) showed that maximum leaf length (13.90 cm) was recorded in T_3 (NPK 45g /m^2), whereas the minimum leaf length (9.66 cm) was observed with T_0 (control). T_1 (NPK 15 g/m²), T_2 (NPK 30 g/m^2) and T_4 (NPK 60 g/m²) having leaf length (11.53 cm, 12.16 and 11.70 cm respectively). So, it was concluded that for improvement in leaf length and other growth and quality parameters were observed when appropriate amount of fertilizers were added. These results further proved by Mahgoub et al., (2006).

Number of leaves/ plant

Number of leaves in saffron was influenced by the application of varying levels of NPK. The data (Fig 3) showed that maximum number of leaves (12.26) was recorded in T_3 (NPK 45g /m^2), whereas the minimum number of leaves (6.83) was observed with T_0 (control). T_1 (NPK 15 g/m²), T_2 (NPK 30 g/m^2) and T_4 (NPK 60 g/m²) having number of leaves (9.86, 10.33 and 10.10 respectively). So, it was concluded that for improvement in number of leaves and other growth and quality parameters were observed when appropriate amount of fertilizers were added. These results further confirmed by Emam et al. (2007).

Flower size (cm)

Flower size of saffron was influenced by the application of varying levels of NPK. The data (Fig 4) showed that maximum flower size (8.20 cm) was recorded in T_3 (NPK 45g /m^2), whereas the minimum flower size (5.30 cm) was observed with T_0 (control). T_1 (NPK 15 g/m²), T_2 (NPK 30 g/m^2) and T_4 (NPK 60 g/m²) having flower size (6.20, 7.40 and 7.06 cm, respectively). So, it was concluded that for improvement in flower size and other growth and quality parameters were observed when appropriate amount of fertilizers were added. These results also reported by Behzad et al., (1992).

Fresh flower weight (g)

In saffron fresh flower weight was influenced by the application of varying levels of NPK. The data (Fig 5) showed that maximum fresh flower weight (1.613 g) was recorded in T_3 (NPK 45g /m^2), whereas the minimum fresh flower weight (0.64 g) was observed with T_0 (control). T_1 (NPK 15 g/m²), T_2 (NPK 30 g/m^2) and T_4 (NPK 60 g/m²) having fresh flower weight (1.01, 0.99 and 0.89 g, respectively). So, it was concluded that for improvement in fresh flower weight and other growth and quality parameters were observed when appropriate amount of fertilizers were added. These results further confirmed by Naderi et al. (2008).

Corm size (cm)

Size of corm in saffron was influenced by the application of varying levels of NPK. The data (Fig 6) showed that maximum corm size (2.26 cm) was recorded in T_3 (NPK 45g /m^2), whereas the minimum corm size (1.29 cm) was observed with T_0 (control). T_1 (NPK 15 g/m²), T_2 (NPK 30 g/m^2) and T_4 (NPK 60 g/m²) having corm size (1.49 cm, 1.98 and 1.72 cm, respectively). So, it was concluded that for improvement in corm size and other growth and quality parameters were observed when appropriate amount of fertilizers were added. These results also confirmed by Jahan and jahani, (2007).

Corm weight (g)

Corm weight in saffron was influenced by the application of varying levels of NPK. The data (Fig 7) showed that maximum corm weight (4.25 g) was recorded in T_3 (NPK 45g /m^2), whereas the minimum corm weight (3.33 g) was observed with T_0 (control). T_1 (NPK 15 g/m²), T_2 (NPK 30 g/m²) and T_4 (NPK 60 g/m²) having corm weight (3.65, 3.89 and 3.76 g, respectively). So, it was concluded that for improvement in corm weight and other growth and quality parameters were observed when appropriate amount of fertilizers were added. These results also in line with Mukesh et al., (2001).
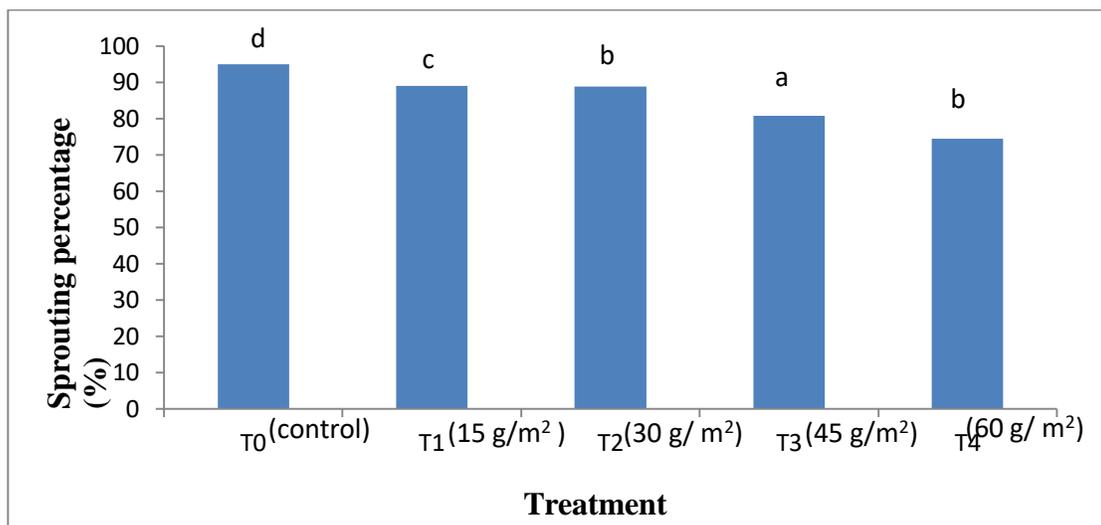
Fig 1: Sprouting percentage of *Crocus sativus* as influenced by varying levels of NPK application.

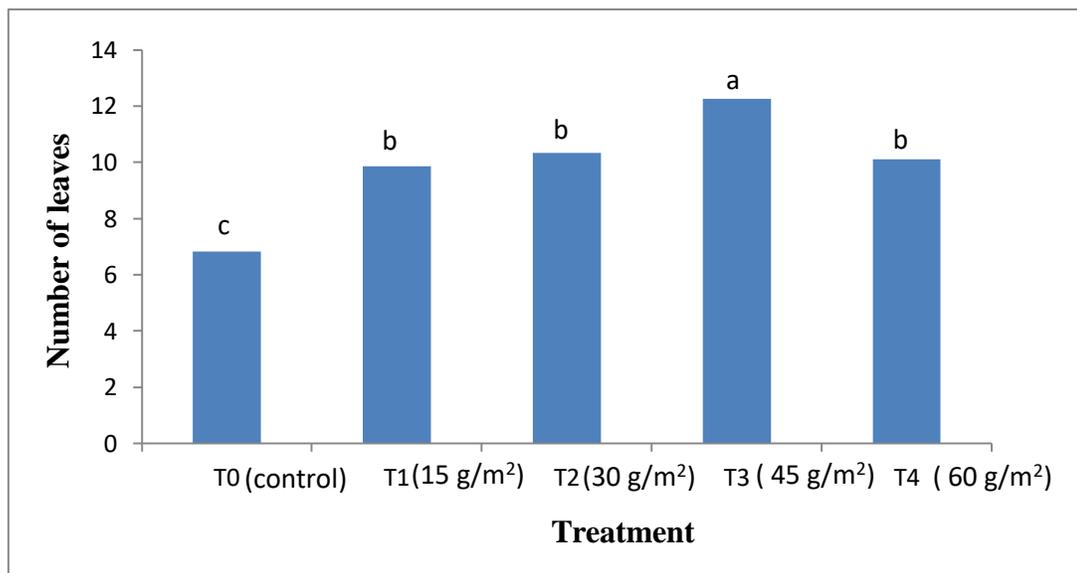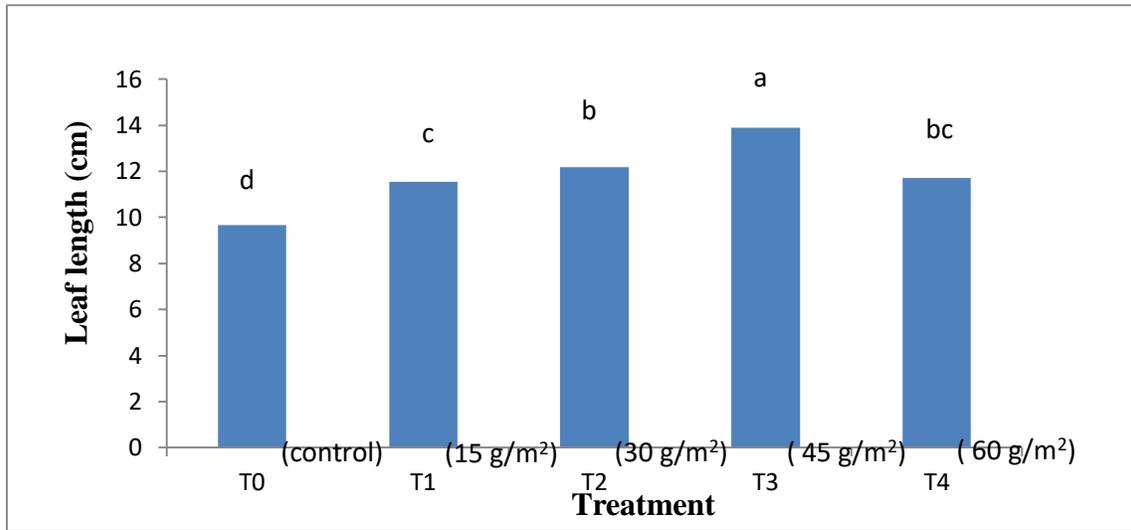**Fig 2: Leaf length of *Crocus sativus* as influenced by varying levels of NPK application**

Fig 3: Number of leaves plant^{-1} of *Crocus sativus* as influenced by varying levels of NPK application.
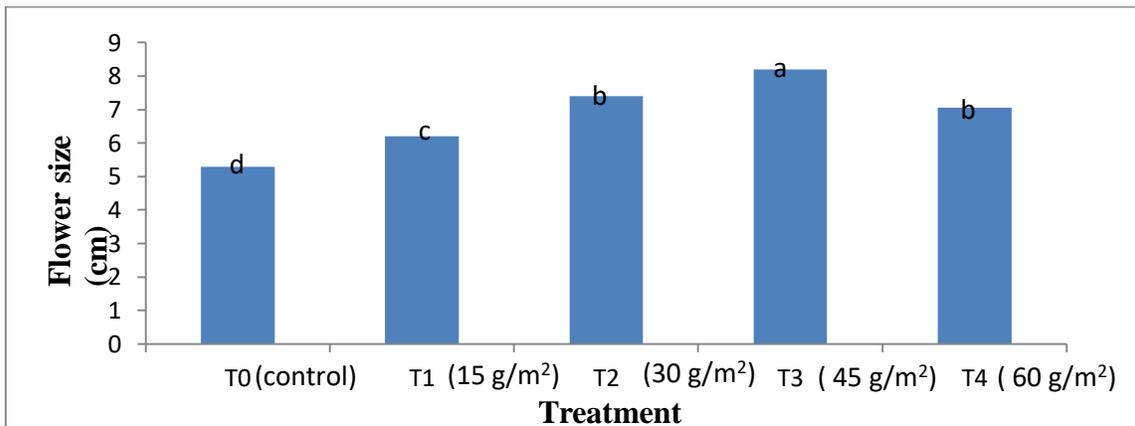

Fig 4: Flower size (cm) of *Crocus sativus* as influenced by varying levels of NPK application
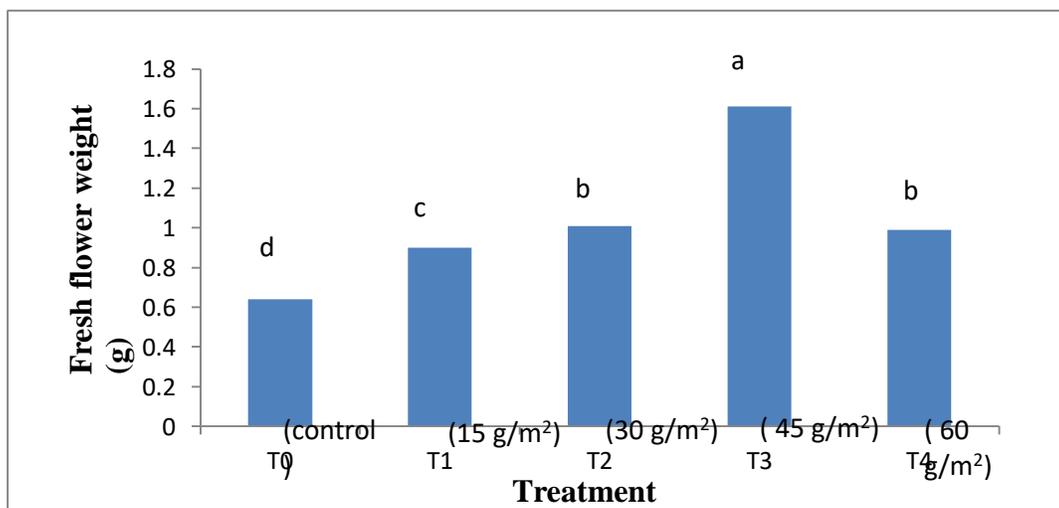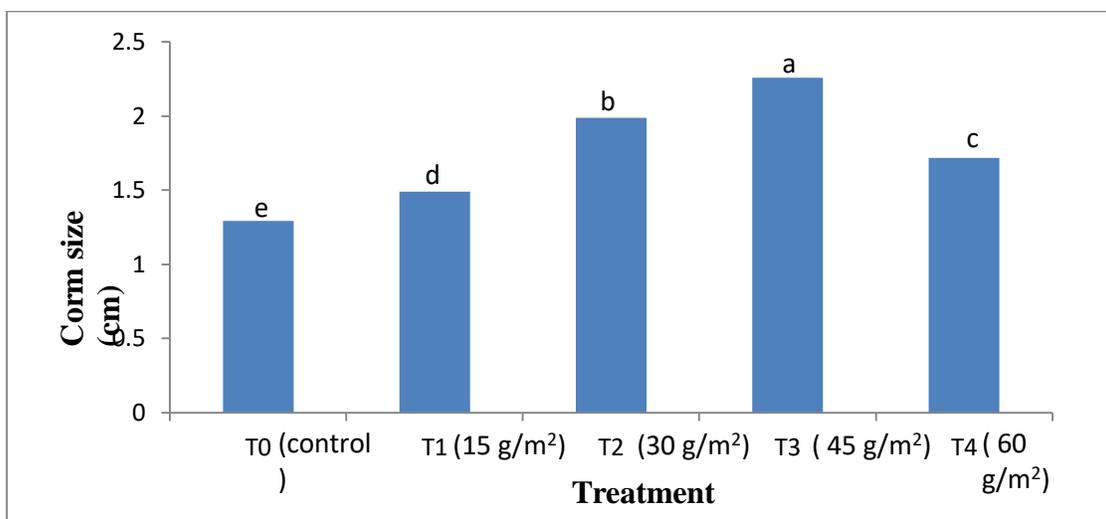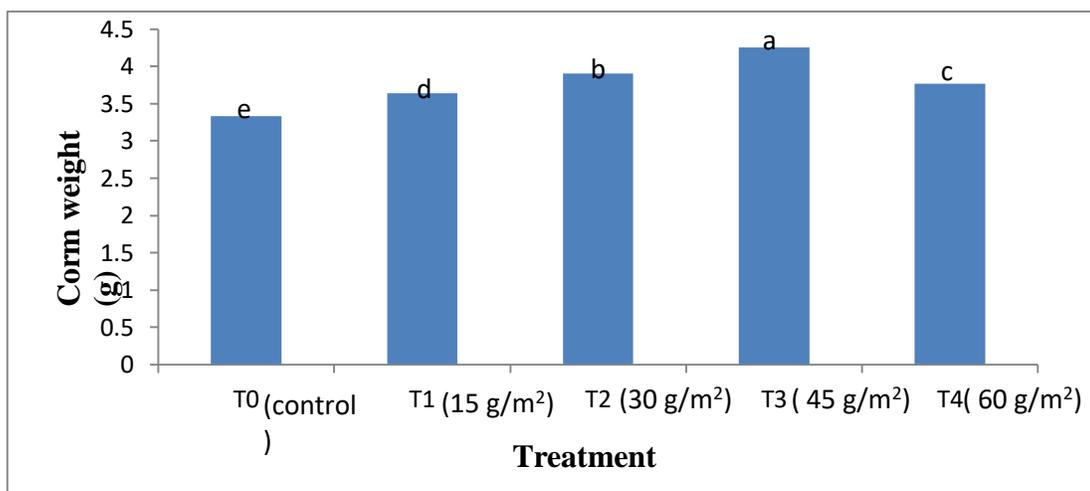

Fig 5: Flower Fresh Weight of *Crocus sativus* as influenced by varying levels of NPK application

Fig 6: **Corm size of *Crocus sativus* as influenced by varying levels of NPK application**

Fig 7: **Corm weight of *Crocus sativus* as influenced by varying levels of NPK application**

CONCLUSION

It is concluded that an appropriate dose of NPK at (45 g/ m^2) had highly significant influence on Sprouting percentage, leaf length, number of leaves/ plant, flower size, flower fresh weight, corm size, corm weight and all other growth and quality parameters in saffron. Application of NPK at 45 g/m^2 (T_3) showed maximum growth while minimum results were observed in T_o (control). These results indicate that NPK have good influence on saffron quality and growth at an appropriate amount because in T_4 in which maximum dose (60 g/ m^2) was used which showed non-significant influence as compared to T_2 and T_3. So, It is concluded from the findings of this study it may be recommended that for attaining best growth and quality in saffron, dose of NPK at (45 g/ m^2) is best.

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