The Effects of Chemical and Organic Fertilizers on Saffron Flowering

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Abstract

The effects of chemical and organic fertilizers on saffron (*Crocus sativus*) were studied in a field experiment using a complete randomized block design with three replications at ferdowsi university of Mashhad. Fertilizers applied were N, P, K, NP, NK, PK, NPK, cow, sheep and chicken manure. The amount of chemical fertilizer applied were 50, 30, 30, 48, 48, 36, 66 kg/ha for N, P, K, NP, NK, PK, NPK and 12, 8, 4 t/ha for cow, sheep and chicken manures, respectively. The results indicated that number and weight of flower and stigma dry weight were affected by type of fertilizers ($p<0.01$). The highest flower number was obtained with cow manure and the lowest with N, NK and PK fertilizers. The highest stigma dry weight was obtained with cow manure (0.093 g/m^2) and lowest with PK treatments (0.035 g/m^2). The highest flower dry weight was obtained with NPK and the lowest with N and PK application (0.92 and 0.33 g/m^2), respectively. Stigma dry weight has a stronger correlation with flower number compared to flower dry weight.

INTRODUCTION

Saffron is a plant with unique characteristics. Total world production of this delicate spice has been estimated 220 tones, 90 percent of which this produced in Iran and 98 percent belongs to Khorasan province (Koocheki, 2003; Mollafilabi, 2003; Shahandeh, 1990). Total acreage of saffron in Iran has been estimated 50,000 hectare. An increasing trend in acreage from the year 1988-2001 has been observed with 3.9 percent increase in cultivated area with an average of 22.4 percent rate of increase (Kafi et al. 2001; Sadeghi et al. 1987). Average yield of saffron in Iran during a period of 25 years has been reported to be 4.7 kg/ha (Kafi et al., 2001; Sadeghi et al., 1987). Since saffron is a perennial crop, it has been adapted to organic fertilizers and hence animal manure plays an important role in this respect. Shahandeh, (1990) found that 16-80 percent of saffron yield is attributed to soil variables and 1-10 percent was related to water availability. He further pointed out that soil chemical criteria such as organic content, available phosphorus, mineral nitrogen, and exchangeable potassium and C/N ratio were the most important factors affecting yield of saffron. Koocheki, (2003) in a survey on 28 farms from 5 major saffron producing areas of Southern Khorasan found that coefficient in manure utilization was 19 percent. Saffron is a low nutrient demanding crop (Rahmati, 2004; Vatanpur-e-Azghadi and Mojtahedi, 2003), however, if above ground is harvested completely, for each kilogram dry biomass, 10.2 kg N, 3.2 kg P and 22.8 kg K is removed from the soil (Shahandeh, 1990). The amount of manure used for saffron in Iran varies from 20-80 tones/ha cow manure (Mollafilabi, 2002; Mollafilabi, 2003). It has been shown (Vatanpur-e-Azghadi and Mojtahedi, 2003) that application of small amount of N and P enhances yield of saffron. However, in some part of Khorasan up to 100 kg/ha ammonium phosphate prior to the first irrigation and 100 kg/ha urea at the time of first weeding is applied (Mollafilabi, 2003).

MATERIALS AND METHODS

In growing season of 2005-2006 an experiment with a Complete Randomized

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Block design and three replications was conducted. Ten treatments based on chemical and organic fertilizers including N, P, K, NP, NK, PK, NPK, cow manure, sheep manure and chicken manure were applied. The amount of N, P, K were 50, 30 and 30 kg/ha and the amount of organic manures were 12, 8 and 4 tones/ha for cow, sheep and chicken manure, respectively. Fertilizers were applied before planting. Corms were planted 7/9/2005 on rows 30 centimeters apart, with 50 centimeter distance between each corm, at the dept of 15 centimeter. One week after irrigation, crust was broken and plants emerged on 12/10/2005. Flowering started on 29/10/2005, and continued to the early November. During flowering period, flowers were picked, counted and weighed and stigma was separated. Each part was weighed separately in an oven with 40 °C for 48 hours and these parts were reweighed. Statistical analysis was made with MSTAT-C and Excel. Means were compared with LSD test at 5 % probability level.

RESULTS AND DISCUSSION

Figure 1 shows that the highest yield of saffron was obtained with cow manure (0.09 g/m^2) and the lowest when PK was applied (0.03 g/m^2). Animal manures were more effective in yield increase than chemical fertilizers (Fig.1).

The trend of change in saffron yield and number of flower per square meter is almost the same and in this case (Figure has not been shown), animal manure were superior in terms of number of flower per unit area. Superiority of animal manure in saffron production has been reported in the literature (Kafi et al., 2001; Koocheki, 2003; Mollafilabi, 2003). Although the effect of animal manure appears in the years after plantation but apparent positive effects could be seen in the year of planting too. Effect of animal manure is attributed to enhancement of physical criteria of the soil including better aeration, better water holding capacity and good balance between nutrients in the soil solution and improvement of nutrient exchange between of the soil (Coleman and. Crossley, 1995; Lampkin, 1990). Slow release of nutrients from animal manure during growth period and hence low leaching of the nutrients could also be other criteria for animal manure.

Dry weight of the flower is also higher with animal manure compared with chemical fertilizer (Fig. 2). As a whole, as it is observed cow manure seems to be more effective in yield enhancement and therefore effect of cow manure on all yield components and also weight of flower is more when all three nutrients (NPK) is applied in single application. This positive effect is more pronounced applied separately. Field observation showed that application of organic fertilizers compared with chemical fertilizers caused one week earlier flower emergence. Utilization of animal manure has been reported (Koocheki, 2003) to be widespread amongst saffron producing farmer. However in southern Khorasan 43 % of them used chemical fertilizers to some extent. Behdani et al. (2005) found a linear correlation between yield and animal manure application. They also found a positive relationship between application of nitrogenous and phosphorus fertilizer with length of flowering period. In their investigation it was found that 67 % of yield variations were attributed to animal manure and phosphorus fertilizers. Application of fertilizer saffron has been not farly Investigated and there are reports (Mollafilabi, 2003) which emphasize on positive effect of chemical fertilizer up to 100 kg/ha. Relationship between saffron yield (stigma) and dry weight of flower and also saffron yield with number of flower per unit area are shown in figures 3 and 4. As it is expected a high correlation coefficient is observed and in this case number of flowers per square meter is more correlated to saffron yield than dry weight of flowers.

However a weak correlation between dry weight of flower and the number of flower per unit area was observed (Fig. 5). In general the effect of manure compared to chemical fertilizer on saffron yield and yield components of saffron was more pronounced on chemical fertilizer in the first of production. However more work is needed to clarify the results and this experiment will be carried out for the next years.

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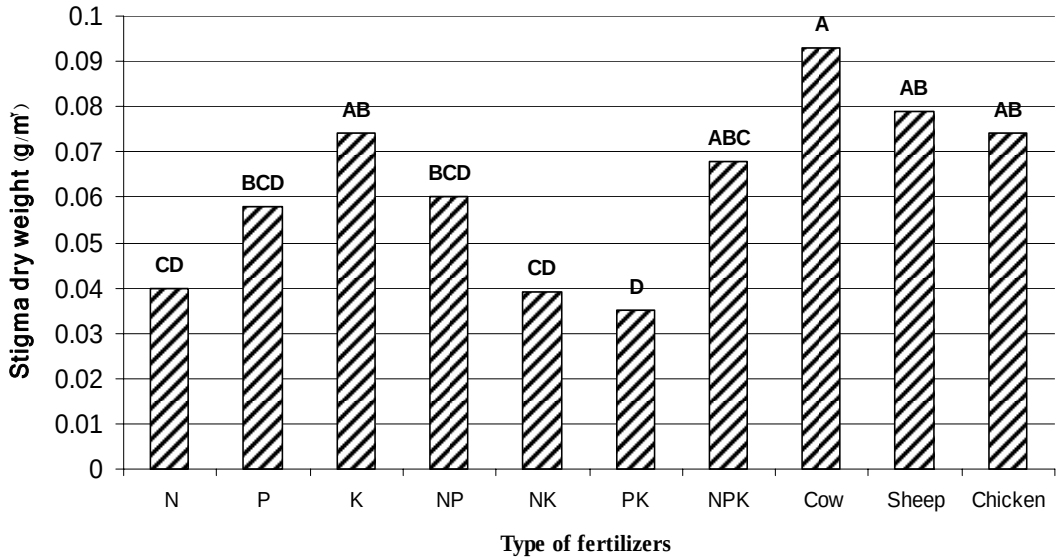

Fig. 1. Means of stigma dry weight for different fertilizers. Means have at least one common letter, have not significant statistical different (p<5%).

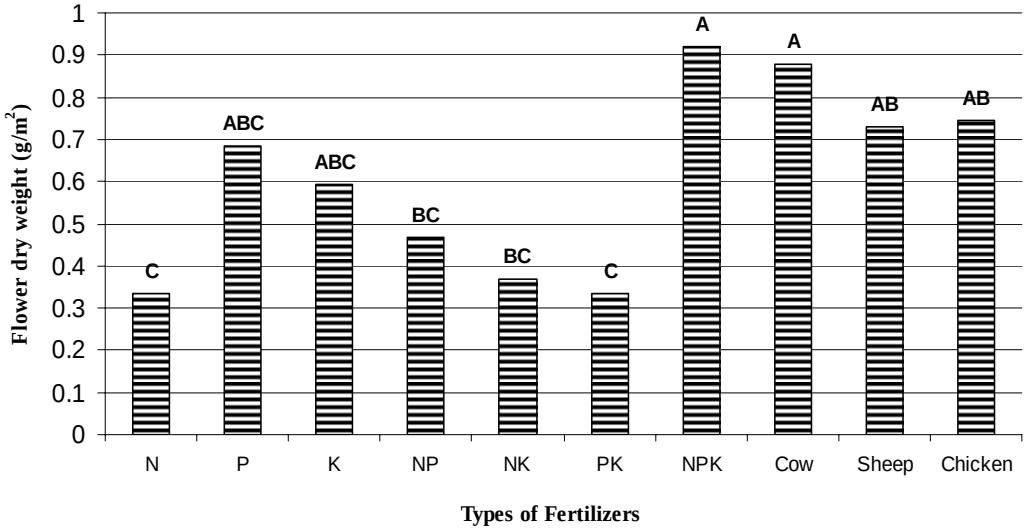

Fig. 2. Means of flower dry weight for different fertilizers. Means have at least one common letter, have not significant statistical different (p<5%).

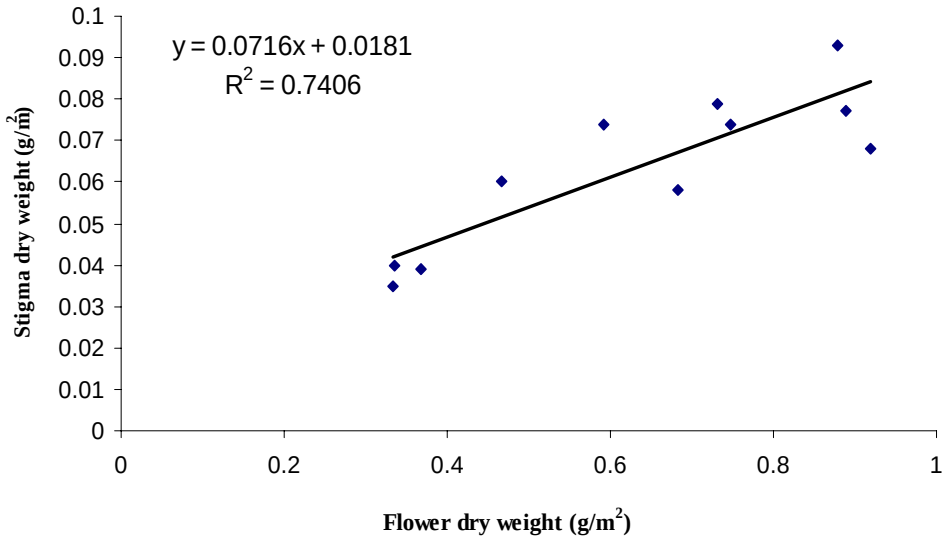

Fig. 3. Correlation between stigma dry weight and flower dry weight.

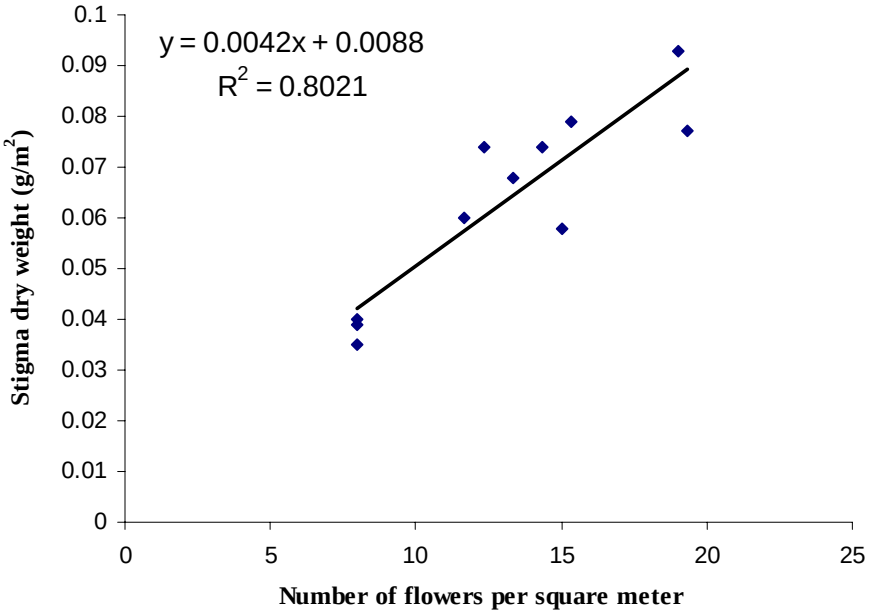

Fig. 4. Correlation between stigma dry weight and number of flowers.

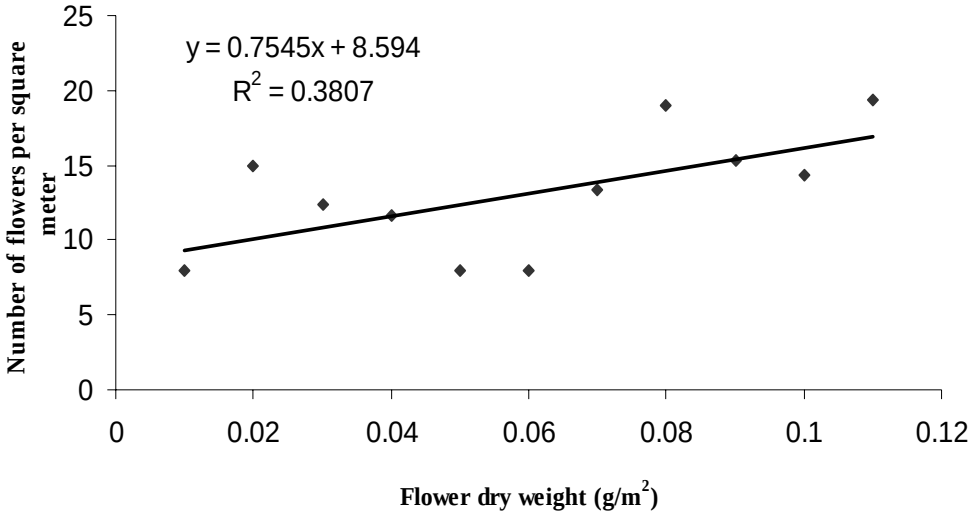

Fig. 5. Correlation between flower dry weight and number of flowers.