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Agronomic ineffectiveness of saffron (*Crocus sativus*) corms obtained from the vermicomposted medium the previous year when grown in the soil the following year

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Abstract
The experiment was conducted under soil in pots to study the growth rate and harmful or useful effects of mother corms of saffron which derived from excessive vermi composted media the before year. Treatments consisted of two rates of vermicompost (50% soil+50% vermicompost, 100% vermicompost) beside 100% soil (control) and two corm diameters (small:20±2 mm and big:32±2 mm). The corms grown in the vermin composted and soil (control) media the previous year were grown only in the soil medium the following year, and it was investigated whether the mother corms from the medium with vermicompost were effective on plant growth. When grown in the soil in the second year, the calculated data were; leaf number, plant height, emerged nodium number, flower number, fresh and dry stigma weight, stigma length, replacement corm number, replacement corm weight, replacement corm diameter, replacement ≥20 mm in diameter corm number, and replacement ≥20 mm in diameter corm weight. In the second year all measured parameters, except replacement corm diameter and replacement ≥20 mm in diameter corm number in small corms, showed no positive or negative effects on the plant, which was derived from mother corms from high vermi composted media. The small and big corms showed differences in all parameters except replacement corm diameter, and replacement ≥20 mm corm weight in previous vermi-composted or soil application in mean. In the overall evaluation, previously applied vermicompost showed no effectiveness on plant aerial part growth, but corm diameter was effective on plant growth.

Keywords: *Crocus sativus*, saffron, vermicompost, excessive organic fertilization

Introduction

There are many studies that describe organic and inorganic fertilizers and their benefits. Most of these were studied in field crops produced from seeds that are cultivated in large areas and were carried out to reveal the yield in the application year (Dimkpa *et al*., 2020; He *et al*., 2022; Jjagwe *et al*., 2020) [4, 5, 6]. In some other studies, there were plants produced from tubers such as potatoes, and most of them were again aimed at observing the differences in yield in the application year (Baniuniene and Zekaite, 2008; Ahmed *et al*., 2019) [3, 1].

Organic fertilizers, which can be of plant, animal, or microorganism origin, are used with the hope of improving soil properties and increasing plant growth. Indeed, some of them change the soil reaction in favor of the plant, while others increase the uptake of essential elements by the plant. Vermicompost is a kind of organic fertilizer that is getting more and more attention. In recent years studies revealing the effect of vermicompost on plant development have gained momentum, and successful results have been obtained (Sallaku *et al*., 2009; Yadav and Kumar, 2023; Zucco *et al*., 2015) [7, 8, 9]. The most important point in this regard is to find the right dose and reveal the abnormalities that may occur in plant development in an overdose. Sometimes excessive and incorrect applications may adversely affect the yield of the plant in the following year. In this case, it is necessary to think differently and make different applications from plant to plant. In the second year, plants produced from vegetative organs such as corms and bulbs, rather than seeds such as saffron, may be affected by the excessive application of organic fertilizers in the previous year.

In this study, the saffron plant was grown in soil as a control and in different ratios (50% and 100% in w/w) of solid vermicompost in the previous year, and the planting of classified saffron bulbs of different diameters and weights from these environments in the following year was carried out in normal soil. Thus, the development differences, beneficial, harmful, or inactive effects of an organic fertilizer such as vermicompost on the plant in the next year have been revealed.

Materials and Methods

In the first year, before the study, corms of saffron (*Crocus sativus* L.), which are 35±5 mm in diameter were grown into black plastic nursery crates each 54 x 36 x 30 cm in length, width, and height. The three crates consisted of 100% (w/w) soil,; the other three crates consisted of 50% Soil+50% (w/w) vermicompost; and the last three crates consisted of 100% (w/w) vermicompost. The solid vermicompost used was commercial. The crates with corms sown at a distance of 10 cm from each other, were arranged randomly in a plastic high tunnel in September 2020. After 9 months of growing season, the newly formed corms obtained from the 3 different media were arranged as small (20±2 mm in diameter, ca. 3.4 g/corm) and big (32±2 mm in diameter, ca. 11.6 g/corm). The arranged corms were kept in darkness until planting three months later.

In the second year of the experiment, the arranged small and big sized corms were grown via sowing at a depth of 8 cm in black plastic nursery bags that were in 20 cm in height and 15 cm in diameter, and consisted of field soil and each bag contained only one corm. The sowing corms were arranged randomly in the plastic high tunnel in September 2021 for nine months without heating or cooling. Agromorphological parameters (Leaf Number, Plant Height, Emerged Nodium Number, Flower Number, Fresh and Dry Stigma Weight, Stigma Length, Replacement Corm Number, Weight and Diameter, Replacement ≥20 mm in diameter Corm Number, and Replacement ≥20 mm in diameter Corm Weight) were measured for obtaining the agronomic effect of corms obtained from vermicomposted medium the previous year when grown in soil the following year.The experiment laid out in a Completely Randomized Design (CRD) consisted of six treatments and with three replicates in each treatment. Each replication had five corms. Totally, the study consisted of 90 sown bulbs in 90 bags. The recorded data on features of vegetative, flower and daughter bulb related, were analyzed through statistical software for observation of whether the parameters were statistically significant or not at the 0.05% level.

Results and Discussions

Responses of vermicompost rates in the previous year on leaf number, plant height, and emerged nodium number were not significant $p \leq 0,05$ which are presented in Table 1, Table 2, Table 3, Fig 1 and Fig 2a. But the data showed that leaf numbers and emerged nodium numbers were always higher in big corms than in small ones. On the other hand, plant heights showed no differences between corm diameters in all media.

Flower number, fresh and dry stigma weight, and stigma length in big corms were not affected by vermicomposted or soil-derived mother corms, while in small corms there was no flowering in any media (Table 4, Table 5, Table 6, Table 7, Figure 2b, Figure 3, Figure 4a). Replacement corm number and replacement corm weight were always higher in big corms than small ones, but before the usage of vermicomposted media, they showed ineffectiveness (Table 8, Table 9, Figure 4b, Fig 5a). Only 50%soil+50% vermicomposted (w/w) substrate gave statistically higher results on replacement corm diameters and ≥20 mm in diameter replacement corm number in small corms (Table 10, Table 11, Figure 5b, Fig 6a). According to the ≥20 mm in diameter replacement corm weight, there are no differences between mother corm diameters or initial substrates (Table 12, Figure 6b).

There are not so many studies about previous fertilizer effects on seeds or seed tubers, corms, bulbs etc. that will be used as planting material next year. One of the rare studies (Baiyeri *et al*., 2011) [2] was on passion fruit seed quality, seedling emergence and growth quality. In the study, poultry manure with or without N+K fertilizers was applied before obtained the seed materials to main plants. In the study, it was found that of nine parameters measured that related to the germination next year, three of them were not influenced by previous fertilization.

Table 1: The number of leaves in the second year of the *Crocus sativus* corms from different substrates when grown in the soil

Vermicompost Rates in The Previous Year (w/w)	Leaf Number (number/plant)		
	Small Corms	Big Corms	Mean
100% Soil	13,17±4,04 a*B**	38,83±11,32 aA	26,00±15,98 A***
50% Soil+50% Vermicompost	13,00±3,99 aB	50,50±2,52 aA	31,75±2,76 A
100% Vermicompost	10,33±1,82 aB	42,47±11,95 aA	26,40±19,19 A
Mean	12,17±3,28 B**	43,93±9,80 A	28,05±17,81

*Lowercase letters indicate that applications were not significantly important at $p \leq 0,05$ level in each corm diameters, **Uppercase letters in the lines indicate that for only one application and the mean for all applications were significantly important at $p \leq 0,05$ level between the corm diameters, ***Uppercase letters in last column indicate that the mean of both corm diameters for among applications was not significantly important at $p \leq 0,05$ level

Table 2: Plant height in the second year of the *Crocus sativus* corms from different substrates when grown in the soil

Vermicompost Rates in The Previous Year (w/w)	Plant Height (cm/plant)		
	Small Corms	Big Corms	Mean
100% Soil	48,27±3,84 a*A**	44,87±2,32 a*A	46,57±3,39 A****
50% Soil+50% Vermicompost	44,73±2,50 aA	39,27±3,04 aA	42,00±3,89 A
100% Vermicompost	45,00±2,62 aA	39,87±2,21 aA	42,43±3,55 A
Mean	46,00±3,14 A***	41,33±3,46 B	43,67±4,01

*Lowercase letters indicate that applications were not significantly important at $p \leq 0,05$ level in each corm diameters, **Uppercase letters in the lines indicate that for only one application was not significantly important at $p \leq 0,05$ level between the corm diameters, *** Uppercase letters in the last lines indicate that the mean for all applications was significantly important at $p \leq 0,05$ level between the corm diameter, ****Uppercase letters in last column indicate that the mean of both corm diameters for among applications was not significantly important at $p \leq 0,05$ level

Table 3: Emerged nodium number in the second year of the *Crocus sativus* corms from different substrates when grown in the soil

Vermicompost Rates in The Previous Year (w/w)	Emerged Nodium Number (number/plant)		
	Small Corms	Big Corms	Mean
100% Soil	5,86±2,02 a*B**	10,73±0,92 a*A	8,30±3,01 A***
50% Soil + 50% Vermicompost	4,07±0,99 aB	10,03±0,75 aA	7,05±3,36 A
100% Vermicompost	3,93±0,31 aB	9,15±1,03 aA	6,54±2,94 A
Mean	4,62±1,47 B**	9,97±1,05 A	7,29±3,02

*Lowercase letters indicate that applications were not significantly important at *p*≤0, 05 level in each corm diameters, **Uppercase letters in the lines indicate that for only one application and the mean for all applications were significantly important at *p*≤0, 05 level between the corm diameters, ***Uppercase letters in last column indicate that the mean of both corm diameters for among applications was not significantly important at *p*≤0, 05 level

Table 4: Flower number in the second year of the *Crocus sativus* corms from different substrates when grown in the soil

Vermicompost Rates in The Previous Year (w/w)	Flower Number (flowers/plant)		
	Small Corms	Big Corms	Mean
100% Soil	0,0±0,00 a*B**	0,87±0,83 a*A	0,43±0,71 A***
50% Soil + 50% Vermicompost	0,0±0,00 aB	0,70±0,27 aA	0,35±0,42 A
100% Vermicompost	0,0±0,00 aB	0,40±0,20 aA	0,20±0,25 A
Mean	0,0±0,00 B**	0,66±0,49 A	0,33±0,48

*Lowercase letters indicate that applications were not significantly important at *p*≤0, 05 level in each corm diameters, **Uppercase letters in the lines indicate that for only one application and the mean for all applications were significantly important at *p*≤0, 05 level between the corm diameter, ***Uppercase letters in last column indicate that the mean of both corm diameters for among applications was not significantly important at *p*≤0, 05 level

Table 5: Fresh stigma weight in the second year of the *Crocus sativus* corms from different substrates when grown in the soil

Vermicompost Rates in The Previous Year (w/w)	Fresh Stigma Weight (mg/stigma)		
	Small Corms	Big Corms	Mean
100% Soil	0,0±0,00 a*B**	40,60±4,85 a*A	20,30±22,44 A***
50% Soil+50% Vermicompost	0,0±0,00 aB	33,53±3,28 aA	16,77±18,48 A
100% Vermicompost	0,0±0,00 aB	35,57±6,28 aA	17,78±19,88 A
Mean	0,0±0,00 B**	36,57±5,33 A	18,28±19,17

*Lowercase letters indicate that applications were not significantly important at *p*≤0, 05 level in each corm diameters, **Uppercase letters in the lines indicate that for only one application and the mean for all applications were significantly important at *p*≤0, 05 level between the corm diameter, ***Uppercase letters in last column indicate that the mean of both corm diameters for among applications was not significantly important at *p*≤0, 05 level

Table 6: Dry stigma weight in the second year of the *Crocus sativus* corms from different substrates when grown in the soil

Vermicompost rates in the previous year (w/w)	Dry Stigma Weight (mg/stigma)		
	Small Corms	Big Corms	Mean
100% Soil	0,0±0,00 a*B**	6,63±0,50 a*A	3,32±3,65 A***
50% Soil+50% Vermicompost	0,0±0,00 aB	6,17±0,21 aA	3,08±3,38 A
100% Vermicompost	0,0±0,00 aB	6,33±1,59 aA	3,17±3,61 A
Mean	0,0±0,00 B**	6,38±0,86 A	3,19±3,34

*Lowercase letters indicate that applications were not significantly important at *p*≤0, 05 level in each corm diameters, **Uppercase letters in the lines indicate that for only one application and mean for all applications were significantly important at *p*≤0, 05 level between the corm diameters, ***Uppercase letters in last column indicate that the mean of both corm diameters for among applications was not significantly important at *p*≤0, 05 level

Table 7: Stigma length in the second year of the *Crocus sativus* corms from different substrates when grown in the soil

Vermicompost Rates in The Previous Year (w/w)	Stigma Length (cm/stigma)		
	Small Corms	Big Corms	Mean
100% Soil	0,0±0,00 a*B**	4,27±0,57 a*A	2,13±2,36 A***
50% Soil+50% Vermicompost	0,0±0,00 aB	3,65±0,45 aA	1,83±2,02 A
100% Vermicompost	0,0±0,00 aB	4,06±0,31 aA	2,03±2,23 A
Mean	0,0±0,00 B**	3,99±0,48 A	2,00±2,08

*Lowercase letters indicate that applications were not significantly important at *p*≤0, 05 level in each corm diameters, **Uppercase letters in the lines indicate that for only one application and the mean for all applications were significantly important at *p*≤0, 05 level between the corm diameters, ***Uppercase letters in last column indicate that the mean of both corm diameters for among applications was not significantly important at *p*≤0, 05 level

Table 8: Replacement corm number in the second year of the *Crocus sativus* corms from different substrates when grown in the soil

Vermicompost Rates in The Previous Year (w/w)	Replacement Corm Number (replacement corms/plant)		
	Small Corms	Big Corms	Mean
100% Soil	5,47±1,68 a*B**	10,13±1,63 a*A	7,80±2,95 A***
50% Soil+50% Vermicompost	4,00±1,04 aB	8,40±1,44 aA	6,20±2,66 A
100% Vermicompost	4,00±0,35 aB	8,20±0,20 aA	6,10±2,31 A
Mean	4,49±1,24 B**	8,91±1,43 A	6,70±2,62

*Lowercase letters indicate that applications were not significantly important at $p \leq 0,05$ level in each corm diameters, **Uppercase letters in the lines indicate that for only one application and the mean for all applications were significantly important at $p \leq 0,05$ level between the corm diameters, ***Uppercase letters in last column indicate that the mean of both corm diameters for among applications was not significantly important at $p \leq 0,05$ level

Table 9: Replacement corm weight in the second year of the *Crocus sativus* corms from different substrates when grown in the soil

Vermicompost Rates in The Previous Year (w/w)	Replacement Corm Weight (g/plant)		
	Small Corms	Big Corms	Mean
100% Soil	5,83±0,40 a*B**	11,53±2,57 a*A	8,68±3,53 A***
50% Soil+50% Vermicompost	5,80±1,14 aB	9,40±1,40 aA	7,60±2,27 A
100% Vermicompost	5,04±1,08 aB	8,81±2,31 aA	6,93±2,62 A
Mean	5,56±0,90 B**	9,91±2,24 A	7,74±2,78

*Lowercase letters indicate that applications were not significantly important at $p \leq 0,05$ level in each corm diameters, **Uppercase letters in the lines indicate that for only one application and the mean for all applications were significantly important at $p \leq 0,05$ level between the corm diameter, ***Uppercase letters in last column indicate that the mean of both corm diameters for among applications was not significantly important at $p \leq 0,05$ level

Table 10: Replacement corm diameter in the second year of the *Crocus sativus* corms from different substrates when grown in the soil

Vermicompost Rates in The Previous Year (w/w)	Replacement Corm Diameter (mm/replacement corm)		
	Small Corms	Big Corms	Mean
100% Soil	11,53±0,71 b*A***	12,53±0,55 a**A	12,03±0,79 B****
50% Soil+50% Vermicompost	13,40±0,10 aA	13,63±0,68 aA	13,52±0,45 A
100% Vermicompost	12,32±0,74 abA	13,60±1,04 aA	12,96±1,07 AB
Mean	12,42±0,96 A***	13,26±0,87 A	12,84±0,99

*Lowercase letters indicate that applications were significantly important at $p \leq 0,05$ level in the corm diameters, **Lowercase letters indicate that applications were not significantly important at $p \leq 0,05$ level in the corm diameters, ***Uppercase letters in the lines indicate that for only one application and the mean for all applications significantly were not important at $p \leq 0,05$ level between the corm diameter, ****Uppercase letters in last column indicate that the mean of both corm diameters for among vermicompost applications was significantly important at $p \leq 0,05$ level

Table 11: Replacement corm (≥20 mm in diameter) number in the second year of the *Crocus sativus* corms from different substrates when grown in the soil

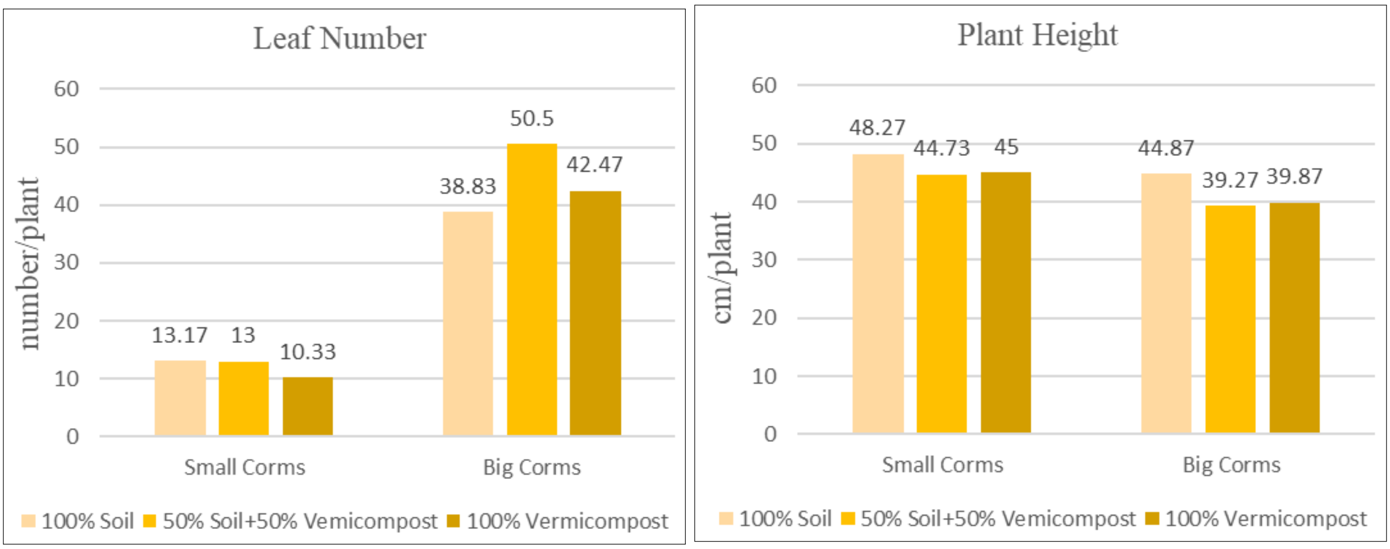
Vermicompost rates in the previous year (w/w)	Replacement Corm (≥20 mm in diameter) Number (replacement corms ≥20 mm in diameter number/plant)		
	Small Corms	Big Corms	Mean
100% Soil	0,40± 0,20 b* B**	1,47±0,12 a** A	0,93±0,60 A***
50% Soil+50% Vermicompost	0,80±0,00 a A	0,80±0,35 a A	0,80±0,22 A
100% Vermicompost	0,27±0,12 b A	0,93±0,46 a A	0,60±0,47 A
Mean	0,49±0,27 B**	1,07±0,42 A	0,78±0,46

*Lowercase letters indicate that applications were significantly important at $p \leq 0,05$ level in the corm diameters, **Lowercase letters indicate that applications were not significantly important at $p \leq 0,05$ level in the corm diameters, ***Uppercase letters in the lines indicate that for only one application and the mean for all application significantly were important at $p \leq 0,05$ level between the corm diameter, ***Uppercase letters in last column indicate that the mean of both corm diameters for among vermicompost applications was not significantly important at $p \leq 0,05$ level

Table 12: Replacement corm (≥20 mm in diameter) weight in the second year of the *Crocus sativus* corms from different substrates when grown in the soil

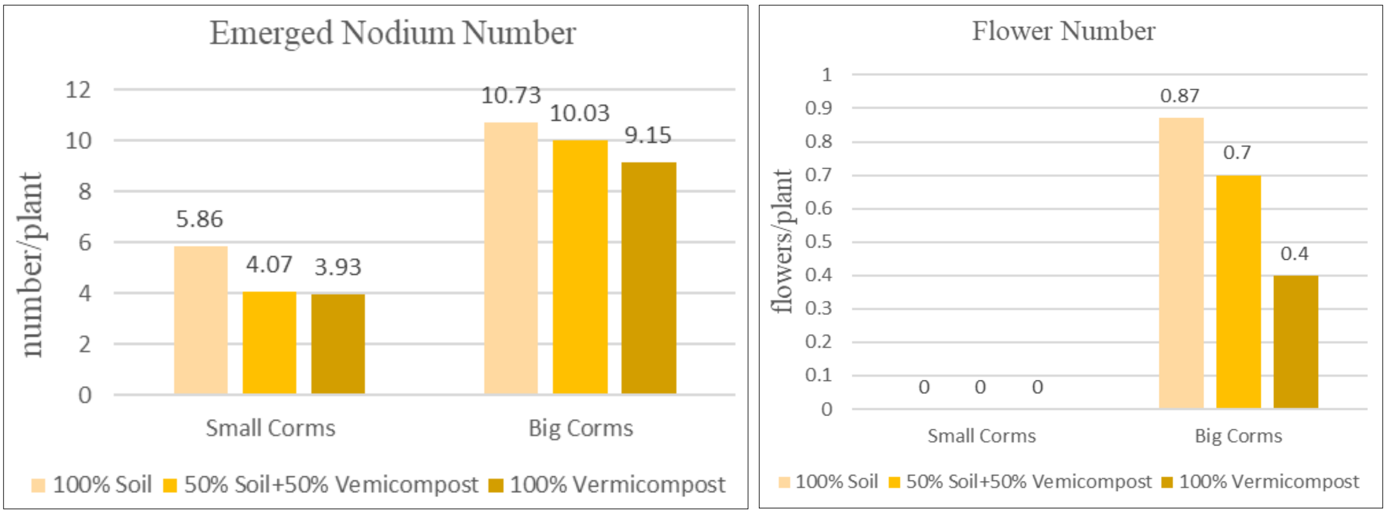
Vermicompost Rates in The Previous Year (w/w)	Replacement Corm (≥20 mm in diameter) Weight (g/replacement corm ≥20 mm in diameter)		
	Small Corms	Big Corms	Mean
100% Soil	4,33±0,31 a*A**	4,10±0,17 a*A	4,22±0,26 A***
50% Soil+50% Vermicompost	3,83±0,31 aA	3,50±0,41 aA	3,67±0,37 A
100% Vermicompost	3,57±1,08 aA	3,56±0, 05 aA	3,56±0,68 A
Mean	3,91±0,67 A	3,72±0,37 A	3,81±0,53

*Lowercase letters indicate that applications were not significantly important at $p \leq 0,05$ level in each corm diameters, **Uppercase letters in the lines indicate that for only one application and the mean for all applications significantly were not important at $p \leq 0,05$ level between the corm diameters, ***Uppercase letters in last column indicate that the mean of both corm diameters for among vermicompost applications was not significantly important at $p \leq 0,05$ level



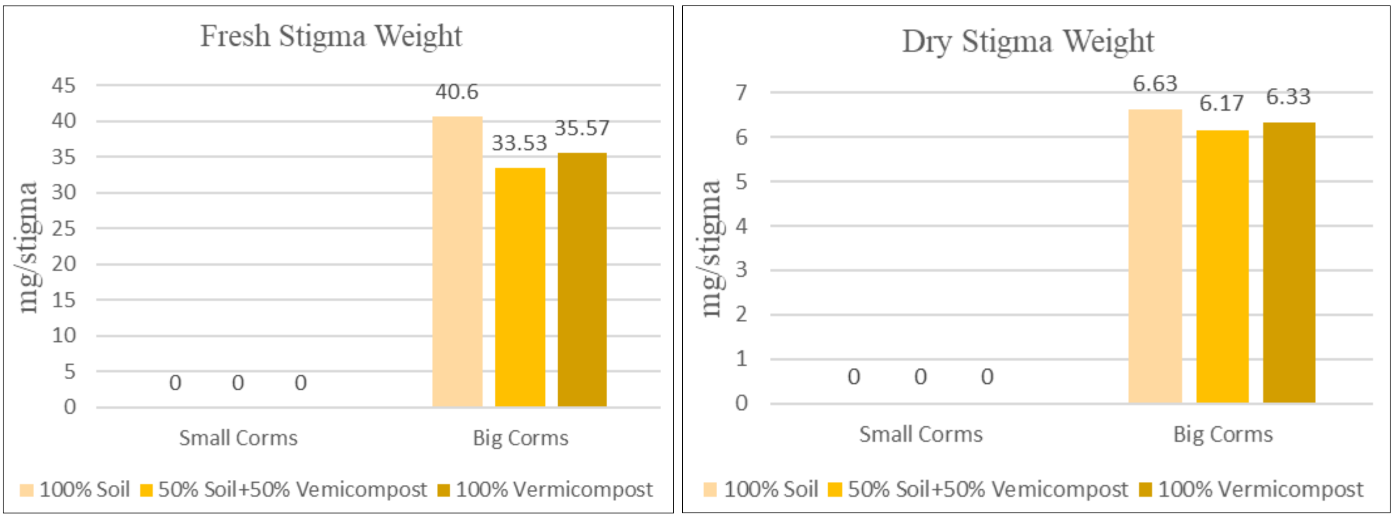
(A) (B)

Fig 1: Vegetative features in the second year of the *Crocus sativus* corms from different substrates when grown in the soil; (a) Leaf number, (b) Plant height



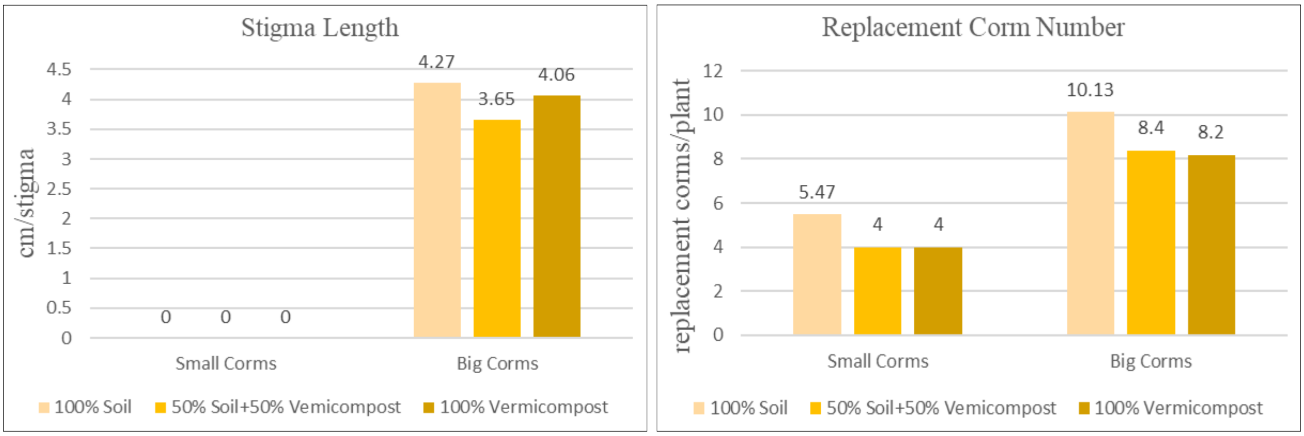
(A) (B)

Fig 2: Nodium and flower features in the second year of the *Crocus sativus* corms from different substrates when grown in the soil; (a) Emerged nodium number, (b) Flower number



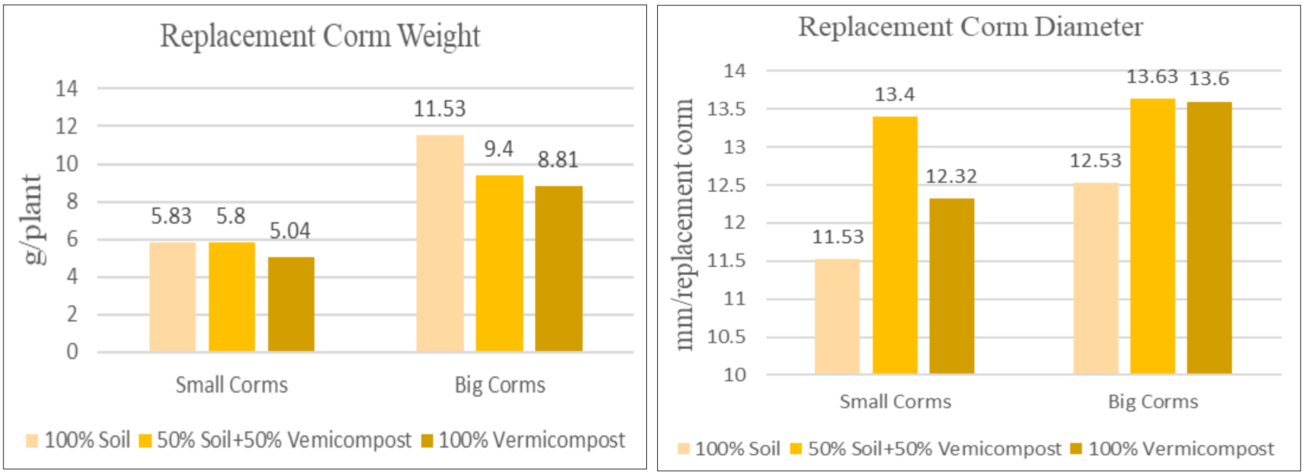
(A) (B)

Fig 3: Stigma features in the second year of the *Crocus sativus* corms from different substrates when grown in the soil; (a) Fresh stigm weight, (b) Dry stigma weight



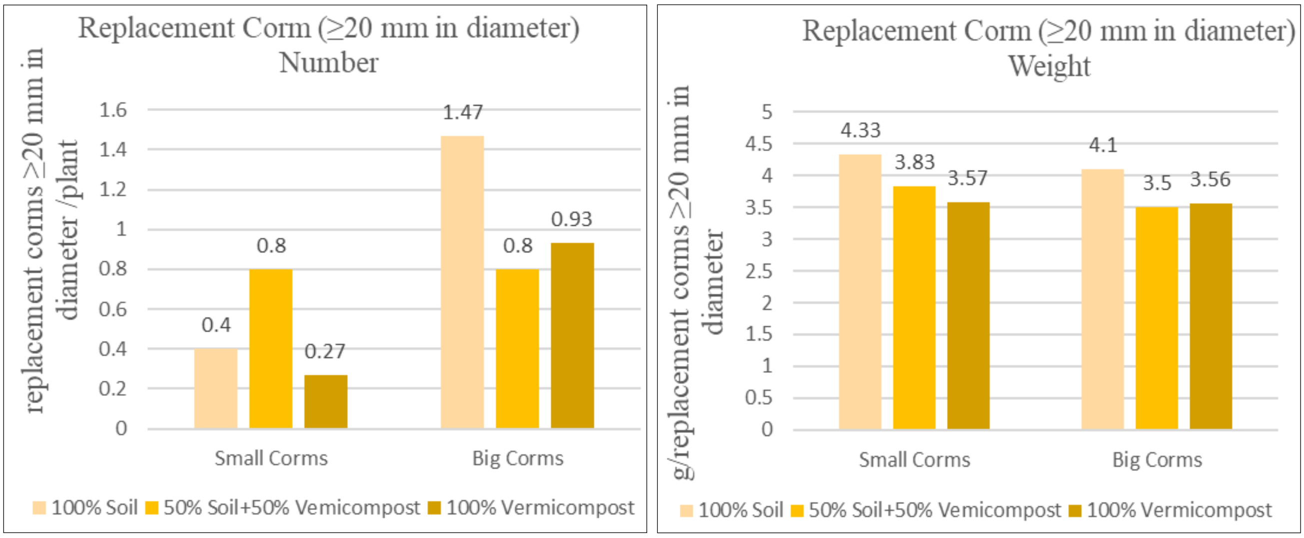
(A) (B)

Fig 4: Stigma and replacement corm features in the second year of the *Crocus sativus* corms from different substrates when grown in the soil; (a) Stigma length, (b) Replacement corm number



(A) (B)

Fig 5: Replacement corm features in the second year of the *Crocus sativus* corms from different substrates when grown in the soil; (a) Replacement corm weight, (b) Replacement corm diameter



(A) (B)

Fig 6: Replacement corm (≥20 mm in diameter) features in the second year of the *Crocus sativus* corms from different substrates when grown in the soil; (a) Replacement corm (≥20 mm in diameter) number, (b) Replacement corm (≥20 mm in diameter) weight

Conclusion

The overall results obtained from this study revealed that *Crocus sativus* L. corm size was always essential to getting higher leaf number, emerged nodium number, flowering, replacement corm number, and weight in all media including 100% soil, 50% and 100% vermicomposted substrates. The results showed that no one of the media was effective on leaf number, plant height, emerged nodium number, flower and related data, replacement corm number, total and ≥20 mm in diameter replacement corm weight in small or big corms separately. Only 50% soil+50% (w/w) vermicomposted media gave statistically higher results on replacement corm diameters and ≥20 mm in diameter replacement corm number in small corms. If a study aimed to reach more flowering, using mother corms that come from excessive vermicomposted media would not be necessary.

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