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The Effects of Simultaneous Application of Different Organic and Biological Fertilizers on Quantitative and Qualitative Characteristics of *Cucurbita pepo* L.

Mohsen Jahan, Alireza Koocheki, Mohammad-Kazem Tahami, Mohammad-Behzad Amiri and Mahdi Nassiri-Mahallati

Agronomy and Plant Breeding Department, Agroecology Division, Faculty of Agriculture, Ferdowsi University of Mashhad (FUM), Mashhad, Iran

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Abstract: Understanding the relations and interactions between ecosystem components and plants is crucial for sustainable production of medicinal plants. To study the effect of simultaneous application of organic and biological fertilizers on yield and yield components of zucchini squash, split plot arrangement of factors based on randomized complete block design with three replications were used during 2009-2010 growing season. The mainplot factors were the type of organic fertilizers, including: (1) cow manure; (2) sheep manure; (3) chicken manure; (4) vermicompost; and (5) control. The subplot factors were the biofertilizes (Nitragin, containing *Azotobacter* sp., *Azospirillum* sp. and *Pseudomonas* sp.) utilization. The results showed the positive but non-significant effect of organic and biological fertilizers on yield and yield components of zucchini squash. Amongst the organic fertilizers, cow and chicken manure, have superiority compared to others. The highest seed oil and protein percent was obtained with application of chicken manure, however there was no significant difference between treatments in seed oil percent. The positive effect of organic and biological fertilizers on seed yield was higher than fruit yield. At a glance, application of cow manure solely was better than its application with nitragin. Nitragin application has no significant effect on some traits when utilized with sheep manure and vermicompost.

Key words: *Cucurbita pepo* L., organic fertilizers, nitragin, growth characteristics.

1. Introduction

The cropping of medicinal plants could positively contribute to the income of organic farms as the guidelines for good agricultural practice for medicinal and spice plants demands products which are not contaminated by chemicals [1]. The requirements with view to homogeneity and quality, particularly the content of bioactive components are continuously increasing so that adequate crop-specific growth conditions need to be elaborated. Growth conditions such as temperature, light intensity and species [2], nutritional factors like nitrogen, phosphorus and sulfur supply, influencing the content of bio-active components [3] and research needs to be carried out for fertilizer recommendations in organic farming which meet market requirements [4]. On the other hand, understanding of relations and interactions between ecosystem's components and plants is one of the main conditions for sustainable production of medicinal plants.

In recent years, cultivation of medicinal plants and other food plants with medicinal properties have been expanded. *Cucurbita pepo* is an important oil seed plant which is used in food and also in cosmetics and health items [5]. Murkovich et al. [6] worked on

Corresponding author: Mohsen Jahan, Ph.D., assistant professor, research fields: biofertilizers and organic farming. E-mail: jahan@um.ac.ir.

hundred lines of this species and found 39.5%-56.5% oil and 21%-67.4% linoleic acid content.

The new utilizations and progressive of *C. pepo* in recent years [7], call for the more researches, especially in low input systems. Due to lack of information about simultaneous application of different organic and biological fertilizers on healthy production of *Cucurbita pepo* L. in a low input system, the project studies were carried out.

2. Materials and Methods

An experiment based on randomised complete block design with split plot arrangement and three replications were conducted in Research Farm of Ferdowsi University of Mashhad in 2009-2010 growing season. Five organic fertilizers including (1) cow manure, (2) sheep manure, (3) chicken manure, (4) vermicompost and (5) control were allocated to main plots and application and no application of biofertilizer (Nitragin, CFU = 10^8 C/mL, containing *Azotobacter* sp. and *Azospirillum* sp.) were assigned to subplots. Planting was carried out on May 8, 2009 on rows 3 m apart with 50 cm between each plant on rows. Just before planting, the seeds inoculated with nitragin, respecting standard conditions (particularly avoiding of direct sunlight) and recommendations of producer company. No chemical fertilizer or biocide was applied and weed was controlled by hand. Irrigation was carried out on the weekly bases. The soil type of the experimental field was sandy clay loam with a pH of 7.4-7.7 and 0.25%-0.30% organic matter. Soil analysis showed 0.057 % of total N, 15 ppm and 119 ppm for available P and K, respectively. The main nutrient elements contents of organic fertilizers used have showed in Table 1. According to squash nutrients requirement and manures and soil analysis results, the amounts of 30, 30, 25 and 10 t/ha of cow manure, sheep manure, chicken manure and vermicompost were used, respectively.

Every 15 days after flowering stage toward, SPAD readings were recorded with SPAD-502 DL, MINOLTA. In the mid of flowering stage, relative water content of leaves (RWC) were measured. At the physiological maturity stages, the fruits were harvested and fruit yield, seed yield, fruits number per m^2, seeds number per m^2, seed weight and seed oil and protein content were determined. The oil and protein content of the seeds were determined using the AOAC Official Method 972.28 (41.1.22) and 968.06, respectively [8]. In order to approved the data have normally distribution, a normality test was carried out, then data were analyzed by analysis of variance (ANOVA) and regression using Minitab statistical software Ver. 14 and means were compared using Duncan's multiple range test at 0.05 probability level.

3. Results and Discussion

3.1 Organic Fertilizers

Chicken manure application had superiority over to other organic fertilizers due to fruit and seed yield, fruit and seed number per m^2, individual fruit weight, seed weight per fruit, RWC, protein and seed oil content and SPAD readings, although this effect was not significant (Table 2). Physiochemical modifications occurred in soil by chicken manure was more compared to other organic fertilizers and it may be to high N and P content of chicken manure (Table 1). In addition, nutrients released from manure were available for plants at the squash rapid growth stage,

Table 1 Nutrient contents of different organic fertilizers used in the experiment.

	N (%)	P (%)	K (%)
Cow manure	1.18	0.29	1.04
Sheep manure	1.21	0.47	0.92
Chicken manure	2.14	2.35	0.78
Vermicompost	1.63	1.53	0.96

Table 2 Means comparison of the effects of organic and biological fertilizers on some traits of *Cucurbita pepo*.

	Fruit yield (t/ha)	Seed yield (g/m^2)	Fruit number per m^2	Seed number per m^2	Single fruit weight (kg)	Seed weight per fruit (g)	1000 seed weight (g)	RWC (%)	Seed oil content (%)	Seed protein content (%)	SPAD reading
Cow manure	6.0a	16.0a	0.42a	117a	1.1a	28.6a	105a	73.9a	35.1a	29.2d	46.2a
Sheep manure	2.9a	11.8a	0.25a	48a	1.15a	25.9a	102a	70.5a	31.6a	39.1c	46.2a
Chicken manure	8.9a	16.7a	0.50a	125a	1.6a	38.2a	132a	74.9a	38.0a	41.5a	46.4a
Vermicompost	5.8a	9.0a	0.29a	65a	1.5a	23.0a	108a	68.6a	35.2a	24.6a	45.5a
Control	8.1a	14.4a	0.44a	119a	1.7a	32.9a	121a	71.0a	35.0a	40.4b	45.2a
Nitragin	5.8a	14.3a	0.37a	91a	1.3a	30.7a	108a	69.7a	35.4a	32.4b	45.7a
No Nitragin	6.8a	12.8a	0.39a	97a	1.5a	28.9a	119a	73.9a	34.8a	37.5a	46.1a

For each factor and in each column, the values which followed by the same letter, are not significantly different at 5% level.

thus, nutrients leaching reduced to a minimum level [9-11].

In each column, means followed by the same letters have not significantly difference ($P < 0.05$).

As it was shown on Fig. 1, SPAD readings were high in all organic fertilizers compared to control at the end of growing season. There are evidences that indicating cattle manure application increased leaf chlorophyll content and growth of some crops [18].

3.2 Biofertilizers

Nitragin inoculation resulted in the higher seed yield, seed weight per fruit and seed oil content rather than no nitragin application, although there was no significant difference between application and no application of nitragin due to these traits (Table 2). There are evidences indicating the positive and promotional effects of rhizobacteria on plant growth and development [12, 13]. These effects assigned to microbial activities in synthesis of phytohormones, organic acids and vitamins, nitrogen fixing, increased some nutrients availability like phosphorus and finally interactions between PGPRs and other soil microorganisms in the rhizosphere which benefits the plant growth [12, 14, 15].

3.3 Interaction of Organic Fertilizers and Biofertilizers

The positive effect of nitragin on seed yield was more revealed than fruit yield (data not shown). As it was shown in Fig. 2, nitragin inoculation resulted in higher seed yield when combined with sheep manure, vermicompost and in control treatment, however, when nitragin combined with cow and chicken manure,

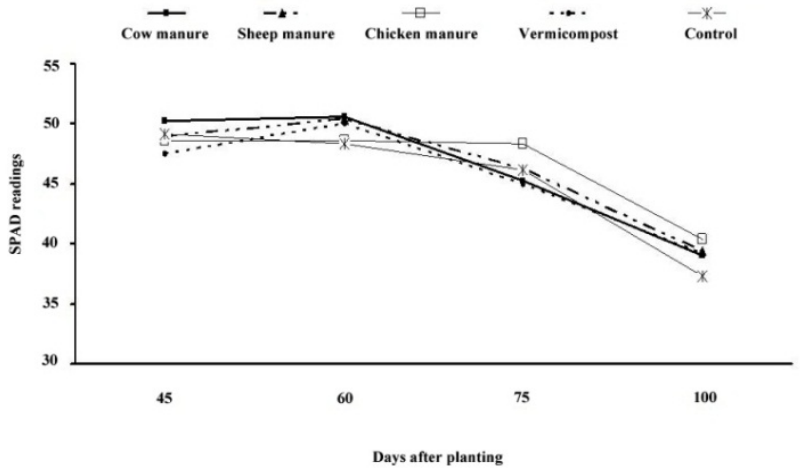

Fig. 1 *C. pepo* SPAD readings trend through growing season resulted from application of different organic fertilizers.

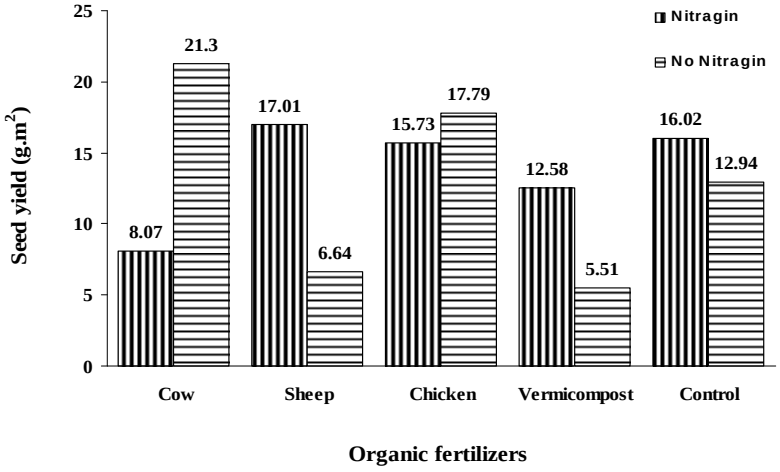

Fig. 2 Interaction of different organic and biological fertilizers on seed yield of *Cucurbita pepo*.

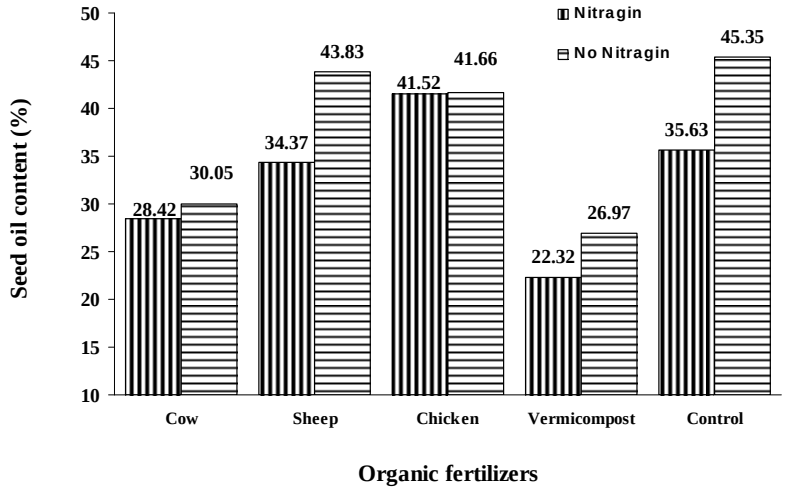

Fig. 3 Interaction of different organic and biological fertilizers on seed oil content of *Cucurbita pepo*.

it seems that positive effect was not appeared, even though, there was no significant difference between seed yield resulted in chicken manure with and without nitragin inoculation.

Interaction of organic and biological fertilizers, on seed weight, fruit and seed number per area unit, and single fruit weight were similar and have superiority on control (data not shown).

It was reported that combined utilization of vermicompost and compost, with *Pseudomonas* and *Azotobacter*, increased fennel yield significantly compared to solely utilization of compost, vermicompost, *Pseudomonas* and control [16]. Other researches have emphasised on positive effects of vermicompost on soil and plants characteristics [10, 17].

The highest seed oil percent resulted from chicken manure without nitragin inoculation and the lowest amount observed in plants treated with sheep manure plus nitragin inoculation (Fig. 3).

Interaction of organic and biological fertilizers was resulted in significant difference amongst treatments regarding to seed protein content (data not shown).

4. Conclusions

In general, the results showed amongst organic fertilizers used in this experiment, the chicken manure solely or combined with nitragin, has superiority

compared to other organic fertilizers, although, chicken and sheep manure, and vermicompost application in combination with or without nitragin inoculation, were not resulted in significant differences due to most studied traits. Cow manure solely application was better than in combination with nitragin.

At a glance, utilization of biofertilizer combined with organic fertilizers could be resulted to an optimum quantitative and qualitative yield without any agrochemicals in a low input production system of zucchini squash.

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