



E-ISSN: 2278-4136

P-ISSN: 2349-8234

JPP 2018; 7(2): 2571-2575

Received: 20-01-2018

Accepted: 21-02-2018

Aradhana Sen

Department of Vegetable and
Spice Crops, Uttar Banga Krishi
Viswavidyalaya, Pundibari,
Coochbehar, West Bengal, India

P Choudhuri

Department of Vegetable
Science, Bidhan Chandra Krishi
Viswavidyalaya, Mohanpur,
Nadia, West Bengal, India

R. Chatterjee

Department of Vegetable and
Spice Crops, Uttar Banga Krishi
Viswavidyalaya, Pundibari,
Coochbehar, West Bengal, India

JC Jana

Department of Vegetable and
Spice Crops, Uttar Banga Krishi
Viswavidyalaya, Pundibari,
Coochbehar, West Bengal, India

Correspondence**Aradhana Sen**

Department of Vegetable and
Spice Crops, Uttar Banga Krishi
Viswavidyalaya, Pundibari,
Coochbehar, West Bengal, India

Influence of inorganic nutrient, organic nutrient and bio-fertilizer on growth, yield and quality of cumin black (*Nigella sativa* L.) in eastern Himalayan region of West Bengal

Aradhana Sen, P Choudhuri, R Chatterjee and JC Jana

Abstract

The cumin black (var. Rajendra Shyama) was cultivated on field under treatments including three nutrient sources i.e., inorganic fertilizer, farmyard manure and bio-fertilizer *Azophos*. Inorganic fertilizers were applied in three levels viz., no fertilizer (C₀), 75% of recommended dose (C₁) and 100% of recommended dose (C₂); farm yard manure (FYM) and *Azophos* was applied in two levels viz., with (F₁) and without (F₀) FYM; with (B₁) and without (B₀) bio-fertilizer. The results showed that C₂ recorded maximum plant height (52.37 cm), leaf chlorophyll (12.37 SPAD), seed per capsule (89.62) and yield per plant (2.06 g). F₁ showed positive influence resulting higher values for plant height (49.38 cm), yield per plant (1.95 g) and seed oil content (32.07 mg/g). B₁ showed higher leaf chlorophyll (12.56 SPAD), seed per capsule (88.72), yield per plant (1.67g), and oil content (32.27 mg/g) over control treatments. The highest seed oil content was recorded when F₁ was used in combination with C₂, which was 15.22% higher over C₂ alone.

Keywords: cumin black, bio-fertilizer, nutrient source, yield

Introduction

Cumin black (*Nigella sativa* L.) is an important seed spice having immense pharmacological potentiality and often considered as miracle medicinal herb. The seeds are used to prepare a highly prized nutritive oil which have been used since many centuries for curing various ailments, widely mentioned in sacred texts and its presence is also reported in Tutenkhamen tomb which gives it a spirituous importance (Padhye *et al.*, 2008) [14]. Cumin black is also reported to be used since long back in the Indian traditional system of medicine like Unani and Ayurveda, even Muslims considers it as one of the greatest forms of healing medicine available because of its mention in one of the Prophetic hadith that black seed is the remedy for all diseases except death. It is also recommended to use on regular basis in Prophetic Medicine (Al-Bukhari, 1976) [3]. Globally, the demand for black cumin seed oil is growing in a faster pace (Padhye *et al.*, 2008) [14]. Garby *et al.* 2015 stated that Agrarian oil cooperatives in Morocco, are incorporating large-scale production of *Nigella* seed oil as potential income source. The oil content of seeds is influenced by various factors like: variety or cultivar, cultural practices, nutritional sources, place of cultivation, processing methods etc (Aytac *et al.*, 2017, Tulukcu., 2011 and Kara *et al.*, 2014) [5, 18, 13]. Among the different factors, nutritional sources significantly influenced the oil content of the seeds and excessive use of chemical fertilizers showed reduction in seed oil content (Aytac *et al.*, 2017) [5]. However, incorporation of more amount of organic source of nutrients significantly improved the oil content of the seeds (Zahedifard *et al.*, 2014) [21]. eastern Himalayan region of West Bengal which is basically terai zone is characterized light soil coupled with high rainfall resulting poor nutrient holding capacity and low organic matter content in soil. Farmers of this zone do not cultivate cumin black on commercial scale. But it has immense potential. But no systematic research works have been carried out on the influence of different nutrient sources on cumin black. Hence the present experiment was undertaken to evaluate the influence of different nutrient sources and their interaction upon growth, yield and quality attributes of cumin black.

Materials and Methods

The present experiment was conducted at the Instructional Farm of Uttar Banga Krishi Viswavidyalaya, Pundbari, Cooch Behar West Bengal, India during rabi seasons of 2015 and 2016. Geographically the Farm is situated at 26° 19' 86" N latitude and 89° 23' 53" E longitude, at an elevation of 43 meter above mean sea level. The area lies under the terai agro climatic zone of West Bengal. The soil was sandy loam in nature, coarse in texture, poor in water holding

capacity with low pH(5.84).the soil was low in organic carbon (0.88 %), low in available nitrogen (153.12 kg/ha),phosphorus (19.49 kg/ha) and potassium (125.05 kg/ha). The experiment was laid out in Factorial RBD with three replications. Three nutrient sources namely inorganic fertilizers (C), Farmyard manure (F) and bio-fertilizer (B) were used in different proportion. Inorganic fertilizers were applied in three levels viz., no fertilizer (C₀), 75% of the recommended dose of fertilizers (C₁) and 100% of the recommended dose of fertilizers (C₂), whereas farm yard manure (FYM) was applied in two levels viz., no FYM (F₀), 100% recommended dose of FYM (F₁).Two levels of bio-fertilizer viz. -with bio-fertilizer (B₁) and without bio-fertilizer (B₀) were applied. Cumin black Seeds (variety Rajendra Shyama) were sown during third week of November in plots of 3 m x 1.5 m. Inorganic fertilizers (30:40:45 kg NPK/ha) along with FYM (15 t/ha) and *Azophos* bio-fertilizer (25g/kg seed) were used and standard cultural practices were adopted to raise the crop. In order to isolate the oil of the seeds, the seeds were extracted by using a Soxhlet apparatus (60°C, 500 ml flask) for 4 hours by solvent distillation method using hexane as solvent in Socsplus- SCR 04R. Number of seeds per capsule were counted by opening the capsule and manually counting the seeds. Two years data from different treatments were statistically analyzed by employing factorial RBD at 5% level of significance. OP STAT statistical software was used for analysis of data.

Results and Discussion

The result of the present experiment showed that increase in dose of chemical fertilizer significantly influenced most of the growth, yield and quality attributes and 100 % recommended dose of chemical fertilizer resulted in significant higher plant height (52.37 cm), leaf chlorophyll content (12.37 SPAD), seed per capsule (89.62), and yield per plant (2.06 g). Yimam *et al.* 2015 also reported that increasing the dose of the fertilizers increased the growth and yield parameters in cumin black. The highest oil content (32.41 mg/g) was found in 75% dose of chemical fertilizer for both the years which was 3.15 % higher than 100 % chemical fertilizer dose. The result is in conformity with the findings of Sardoei *et al.* 2014 in cumin (*Cuminum cyminum*) who reported that increased rate of fertilizer dose decreased the seed oil yield. However the number of primary branches (6.62), secondary branches (12.04), capsule per plant (17.68) were found significant with the highest dose of chemical fertilizer in the first year but found statistically non significant in second year.

In case of organic manure, application of farmyard manure (15 t/ha) recorded the highest plant height (49.38 cm) and yield per plant (1.95 g), oil content (32.07 mg/g) for both the years. The treatment recorded 59.84% higher seed yield 12.49 % more oil content over control.

In case of bio-fertilizer, seed inoculation with *Azophos* bio-fertilizer gave higher leaf chlorophyll content (12.56 SPAD),

seed per capsule (88.72), yield per plot (200.97 g). Which was 6.62 % higher seed per capsule and 11.33 % more seed yield per plant over the control. Farvani *et al.* 2012 also found that application of bio-fertilizers significantly improved growth, quality and yield attributes of cumin black. Bio-fertilizer treatments also recorded higher oil content (32.27 mg/g) and 1000 seed weight (3.13 g) for both the year over the control. Abadi *et al.* (1) also recorded maximum oil content in black cumin treated with *Mycorrhiza* over the controlled treatment. Ghilavizadeh *et al.* 2013, Darzi *et al.* 2013 and Tajpoor *et al.* 2013 also reported higher oil yield of different seed spices in presence of bio-fertilizer as compared to sole application.

The data observed for interaction effect showed that the interaction effect of inorganic fertilizer and organic manure (C₂F₁) recorded the highest leaf chlorophyll content (13.6 SPAD), seed per capsule (93.65), yield per plant (2.56 g) and oil content (33.70 mg/g) for both the years. Seed yield per plant was 65.16% higher over the sole 100% chemical fertilizer. Similarly seed oil content was 17.75% and 31.85% higher over the sole 100% chemical fertilizer and control respectively. Iman and Pariari, 2007 also found similar results for coriander seed yield when vermicompost along with urea was applied.

Interaction of chemical fertilizer and bio-fertilizer was found significant for yield per plant (2.00g) when 100% dose of fertilizer applied with *Azophos* bio-fertiizer where as oil content was found maximum for 75% of fertilizer dose with *Azophos* for both the years. The oil content was increased by 15.22% over the sole application of full dose of chemical fertilizer. Abdel-Azieza *et al.* 2013 observed that productivity and quality of cumin black was improved when *Azotobacter* bio-fertilizer was applied along with half dose of nitrogen fertilizers. Shirmohammadi *et al.* 2014 also observed that plant height, number of capsules, number of seeds per capsules and seed yield of black cumin was significantly influenced by combined application of biological phosphate (bacterial strain *Pseudomonas putida*) and chemical phosphorous.

Interaction effect of organic manure and *Azophos* showed significant influence and recorded highest plant height (51.81 cm) and yield per plant (2.06 g) when farmyard manure and *Azophos* inoculated seeds were used. It was also observed that oil content (33.46 mg/g) was significantly increased when farmyard manure and *Azophos* were applied together which was 9.06% higher over the sole application of organic manure. Azzaz *et al.* 2009 found that interaction of organic manure and bio-fertilizer was effective in fennel plants growth and vegetative characters. Ghanepasand *et al.* 2014 reported that combined use of nitrogen fixing bacteria and manure is more effective in cumin black. Ali and Hassan 2014 observed similar results and stated that volatile and fixed oil content of cumin black increased when cattle manure and bio fertilizers (NFB + PSB) were used as compared to control. Valadabadi and Farhani 2011 also supported that oil content was increased when animal manure and *Azotobacter* was applied together.

Table 1. Effect of inorganic fertilizers, organic manure and bio-fertilizers on growth attributes of cumin black.

Treatment	Plant height (cm)			No. of primary branches			No. of secondary branches			Leaf Chlorophyll content (SPAD)		
	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
Inorganic fertilizers												
C ₀	54.63	37.82	46.23	6.88	4.98	5.93	11.35	8.92	10.14	10.99	10.97	10.98
C ₁	58.68	42.92	50.80	7.80	5.37	6.59	13.98	9.47	11.73	12.47	11.83	12.15
C ₂	60.31	44.42	52.37	7.82	5.42	6.62	14.07	10.00	12.04	12.67	12.06	12.37
S. Em ±	0.74	0.80	0.45	0.22	0.18	0.18	0.40	0.32	0.33	0.40	0.27	0.18
C. D. (0.05)	2.17	2.35	1.39	0.64	NS	0.544	1.16	NS	1.02	1.18	0.79	0.55
Organic manure (Farmyard manure)												
F ₀	55.18	40.44	47.81	7.23	5.18	6.21	12.57	9.17	10.87	11.98	11.53	11.76
F ₁	55.77	42.99	49.38	7.77	5.24	6.51	13.70	9.76	11.73	12.12	11.71	11.92
S. Em.±	0.60	0.65	0.37	0.18	0.14	0.14	0.32	0.26	0.27	0.33	1.27	0.14
C. D. (0.05)	1.77	1.92	1.14	0.52	NS	NS	0.95	NS	0.83	NS	NS	NS
Bio fertilizer (Azophos)												
B ₀	56.42	40.32	48.37	7.04	5.16	6.10	12.18	9.16	10.67	11.20	11.01	11.11
B ₁	59.32	43.11	51.22	7.96	5.36	6.66	14.09	9.77	11.93	12.88	12.23	12.56
S. Em±	0.60	0.65	0.37	0.18	0.14	0.14	0.32	0.26	0.27	0.33	0.22	0.14
C. D. (0.05)	1.77	NS	1.14	0.52	NS	0.44	0.95	NS	0.83	0.97	0.64	0.45
Interaction												
Inorganic fertilizer with organic manure												
C ₀ F ₀	53.90	36.73	45.32	6.50	5.13	5.82	10.73	8.70	9.72	10.16	10.28	10.22
C ₀ F ₁	55.37	38.90	47.14	7.27	4.83	6.05	11.97	9.13	10.55	10.81	10.66	10.74
C ₁ F ₀	56.76	40.57	48.67	7.60	5.31	6.46	13.57	9.75	11.66	10.59	11.24	10.92
C ₁ F ₁	60.60	45.27	52.94	8.00	5.43	6.72	14.40	9.95	12.18	13.35	12.43	12.89
C ₂ F ₀	57.27	44.03	50.65	7.20	5.28	6.24	12.57	9.60	11.09	11.18	11.08	11.13
C ₂ F ₁	63.35	44.80	54.08	8.43	5.57	7.00	15.57	10.40	12.99	14.16	13.04	13.6
S. Em±	1.05	1.34	0.63	0.31	0.25	0.25	0.56	0.45	0.46	0.57	0.38	0.25
C. D. (0.05)	NS	NS	NS	NS	NS	NS	1.64	NS	NS	1.67	1.12	0.77
Inorganic fertilizers with bio-fertilizer												
C ₀ B ₀	53.70	37.40	45.55	6.60	4.90	5.75	10.70	8.53	9.62	10.44	10.26	10.35
C ₀ B ₁	55.57	38.23	46.90	7.17	5.07	6.12	12.00	9.30	10.65	11.53	11.68	11.61
C ₁ B ₀	57.27	40.97	49.12	7.33	5.28	6.31	13.10	9.22	11.16	11.46	11.39	11.43
C ₁ B ₁	60.10	44.87	52.49	8.27	5.47	6.87	14.87	9.73	12.30	13.49	12.28	12.89
C ₂ B ₀	58.30	42.60	50.45	7.20	5.30	6.25	12.73	9.73	11.23	11.72	11.39	11.56
C ₂ B ₁	62.32	46.23	54.28	8.43	5.55	6.99	15.40	10.27	12.84	13.63	12.73	13.18
S. Em±	1.05	1.13	0.63	0.31	0.25	0.25	0.56	0.45	0.46	0.57	0.38	0.25
C. D. (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Organic manure with bio-fertilizer												
F ₀ B ₀	53.44	38.13	45.79	6.78	5.16	5.97	11.51	8.87	10.19	10.24	11.31	10.78
F ₀ B ₁	58.51	42.26	50.39	7.69	5.41	6.55	13.62	9.47	11.55	10.42	11.75	11.09
F ₁ B ₀	59.40	42.51	50.96	7.31	5.17	6.24	12.84	9.46	11.15	10.87	11.72	11.30
F ₁ B ₁	60.14	43.47	51.81	8.22	5.31	6.77	14.56	10.07	12.32	13.35	12.70	13.03
S. Em±	0.85	0.93	0.52	0.25	0.21	0.20	0.46	0.37	0.38	0.46	0.31	0.20
C. D. (0.05)	2.50	2.72	1.61	NS	NS	NS	NS	NS	NS	NS	0.91	0.63

NS: non significant

Table 2: Effect of inorganic fertilizers, organic manure and bio-fertilizers on yield attributes of cumin black.

Treatment	No. of capsule per plant			No. of seeds per capsule			Yield per plant (g)			Oil content (mg/g)		
	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled	2015	2016	Pooled
Inorganic fertilizers												
C ₀	14.24	12.55	13.40	83.13	83.63	83.38	0.95	0.86	0.90	27.84	27.29	27.56
C ₁	17.03	16.32	16.68	84.62	85.15	84.89	1.83	1.72	1.77	32.38	31.90	32.14
C ₂	18.15	17.20	17.68	89.74	89.50	89.62	2.10	2.01	2.06	30.99	31.33	31.16
S. Em ±	0.47	1.55	0.26	0.98	1.23	0.89	0.28	0.23	0.29	0.43	0.39	0.38
C. D. (0.05)	1.39	NS	0.81	2.88	3.61	2.77	0.81	0.64	0.83	1.26	1.15	1.14
Organic manure (Farmyard manure)												
F ₀	15.57	14.77	15.17	82.55	84.26	83.41	1.25	1.19	1.22	28.6	28.41	28.51
F ₁	17.38	15.94	16.66	85.12	87.93	86.53	2.00	1.90	1.95	32.21	31.93	32.07
S. Em.±	0.39	1.27	0.21	0.80	1.00	0.73	0.19	0.21	0.23	0.49	0.32	0.31
C. D. (0.05)	1.14	NS	0.66	NS	2.94	2.26	0.54	0.61	0.66	1.46	0.94	0.92
Bio fertilizer (Azophos)												
B ₀	14.61	13.83	14.22	82.41	84.01	83.21	1.55	1.45	1.50	28.52	20.00	24.26
B ₁	18.34	16.88	17.61	89.26	88.18	88.72	1.70	1.65	1.67	32.28	32.25	32.27
S. Em±	0.39	1.27	0.21	0.80	1.00	0.73	0.28	0.32	0.34	0.72	0.46	0.56
C. D. (0.05)	1.14	NS	0.66	2.35	2.94	2.26	0.80	0.64	0.97	2.11	1.34	1.39
Interaction												
Inorganic fertilizer with organic manure												

C ₀ F ₀	13.97	13.07	13.52	81.20	80.83	81.02	0.67	0.69	0.68	25.92	25.19	25.56
C ₀ F ₁	14.52	12.03	13.28	81.37	82.43	81.90	1.22	1.14	1.18	29.76	29.38	29.57
C ₁ F ₀	15.11	14.17	14.64	80.07	83.40	81.74	1.50	1.37	1.44	31.49	31.19	31.34
C ₁ F ₁	15.94	15.47	15.71	84.17	85.90	85.04	2.15	2.07	2.11	33.26	32.60	32.93
C ₂ F ₀	14.62	14.07	14.35	82.67	83.53	83.10	1.59	1.52	1.55	28.38	28.86	28.62
C ₂ F ₁	21.68	20.33	21.01	91.82	95.47	93.65	2.62	2.50	2.56	33.60	33.80	33.70
S. Em±	0.67	2.19	0.37	1.39	1.74	1.26	0.19	0.17	0.23	0.42	0.47	0.45
C. D. (0.05)	1.97	NS	1.15	4.07	5.10	3.73	0.54	0.49	0.66	1.23	1.38	1.25
Inorganic fertilizers with bio-fertilizer												
C ₀ B ₀	13.55	12.27	12.91	79.97	82.43	81.20	0.89	0.83	0.86	25.38	24.78	25.08
C ₀ B ₁	14.94	12.53	13.74	86.30	84.83	85.57	1.00	1.00	1.00	30.3	29.8	30.05
C ₁ B ₀	15.87	13.10	14.49	80.33	82.03	81.18	1.73	1.52	1.63	30.93	30.57	30.75
C ₁ B ₁	20.18	17.53	18.86	88.90	88.27	88.59	1.92	1.92	1.92	33.82	33.23	33.53
C ₂ B ₀	16.40	15.83	16.12	86.92	87.57	87.25	2.02	1.99	2.00	29.26	28.93	29.1
C ₂ B ₁	19.90	18.57	19.24	92.57	91.43	92.00	2.19	2.03	2.11	32.72	33.77	33.22
S. Em±	0.67	2.19	0.37	1.39	1.74	1.26	0.18	0.20	0.23	0.42	0.47	0.45
C. D. (0.05)	1.97	NS	1.15	NS	NS	NS	0.51	0.57	0.67	1.22	1.38	1.25
Organic manure with bio-fertilizer												
F ₀ B ₀	13.41	12.64	13.03	80.62	82.02	81.32	1.21	1.11	1.16	26.3	25.57	25.94
F ₀ B ₁	16.72	15.89	16.31	81.47	83.49	82.48	1.30	1.28	1.29	30.89	31.26	31.08
F ₁ B ₀	15.80	15.02	15.41	82.19	85.00	83.60	1.89	1.79	1.84	30.74	30.61	30.68
F ₁ B ₁	18.96	16.87	17.92	88.04	90.87	89.46	2.11	2.02	2.06	33.67	33.25	33.46
S. Em±	0.55	1.79	0.30	1.13	1.42	1.03	0.23	0.21	0.19	0.38	0.34	0.36
C. D. (0.05)	NS	NS	NS	NS	NS	NS	0.66	0.62	0.54	1.11	1.00	1.06

NS: non significant

Conclusion

The findings of the experiment showed that maximum seed yield and oil content of cumin black was obtained when farmyard manure was used in combination with 100% chemical fertilizers. Therefore, application of chemical fertilizer along with the organic manure may be promoted to obtain higher yield and quality cumin black seeds in Eastern Himalayan region of West Bengal.

References

- Abadi BHM, Ganjali HR and Mobasser HR. Effect of *mycorrhiza* and phosphorus fertilizer on some characteristics of black cumin. *Biol Forum Int J*. 2015; 7:1115-1120.
- Abdel-Azieza SM, Ewedab WE, Girgisb MGZ and Ghanya BFA. Improving the productivity and quality of black cumin (*Nigella sativa*) by using *Azotobacter* as N₂ biofertilizer. *Annals Agric Sci*. 2013; 59:95-108.
- Al-Bukhari MI. In: The collection of authentic sayings of prophet mohammad (peace be upon him), division 71 on medicine. 2nd ed. Al-Bukhari Sahi., editor. Ankara: Hilal Yayinlari, 1976.
- Ali E and Hassan F. Bio-production of *Nigella sativa L.* seeds and oil in taif area. *Int. J Curr. Microbiol. App. Sc*. 2014; 3:315-328.
- Aytac Z, Gulmezoglu N, Saglam T, Kulan EG, Selengil U, Hosgun HL. Changes in N, K, and Fatty Acid Composition of Black Cumin Seeds Affected by Nitrogen Doses under Supplemental Potassium Application. *Journal of Chemistry Article ID 3162062*, 7 pages, <https://doi.org/10.1155/2017/3162062>, 2017.
- Azzaz NAE, Hassan AE, Hamadi EH. The Chemical Constituent and Vegetative and Yielding Characteristics of Fennel Plants Treated with Organic and Bio-fertilizer Instead of Mineral Fertilizer. *Aust. J Basic Appl. Sci*. 2009; 3:579-587.
- Darzi MT, Shirkhodaei M and Hadi MHS. Effects of vermicompost and *Azotobacter* and *Azospirillum* bacteria on quantity and quality of essential oil of coriander (*Coriandrum sativum L.*). *Intl J Farm & Alli Sci*. 2013; 2:1277-1283.
- Faravani M, Koorepaz S, Gholami BA and Zare Y. Biological effects of fertilizer treatments on growth, yield and yield components of black cumin. *Herba Pol*. 2012; 58:14-28.
- Ghanepasand F, Mohamadi GN, Hadi MRH and Darzi MT. Influence of manure application and nitrogen fixing bacteria on yield and yield components of black cumin (*Nigella sativa L.*). *Intl. J Adv Biol & Biomed. Res*. 2014; 2:628-635.
- Gharby S, Harhar H, Guillaume D, Roudani A, Boulbaroud S, Ibrahim M *et al.* Chemical investigation of *Nigella sativa L.* seed oil produced in morocco. *J Saudi Society Agric. Sci*. 2015; 14:172-177.
- Ghilavizadeh A, Darzi MT and Hadi MHS. Effects of biofertilizer and plant density on essential oil content and yield traits of ajowan (*Carum copticum*). *Middle-East J*. 2013; 14:1508-1512.
- Iman MN and Pariari A. Response of different nitrogen sources on growth and yield of coriander (*Coriandrum sativum L.*). *Seed Res*. 2007; 12:75-76.
- Kara N, Katar D and Baydar H. Yield and quality of black cumin (*Nigella sativa L.*) Populations: the effect of ecological conditions. *Turk J Field Crop*. 2014; 20:9-14.
- Padhye S, Banerjee S, Ahmad A, Mohammad R and Sarkar FH. From here to eternity-the secret of pharaohs: therapeutic potential of black cumin seeds and beyond. *Cancer Ther*. 2008; 6:495-510.
- Sardoei AS, Shahdadneghad M, Arsalani A and Sadeghi T. The effect of solopotasse fertilizer on yield and essential oil of cumin (*Cuminum Cyminum L.*). *Intl. J Adv. Biol. & Biomed. Res*. 2014; 2:2529-2533.
- Shirmohammadi E, Khaje M, Shahgholi H and Talaei GH. Effect of biological phosphate and chemical phosphorus fertilizer on yield and yield components of Black cumin (*Nigella sativa L.*) *TI Journals: Agric. Sci. Develop*. 2014; 3:279-283.
- Tajpoor N, Moradi R, Zaeim AN. Effects of various fertilizers on quantity and quality of dill (*Anethum*

- graveolens* L.) essential oil. Intl J Agri Crop Sci. 2013; 19:1334-1341.
18. Tulukcu E. A comparative study on fatty acid composition of black cumin obtained from different regions of Turkey, Iran and Syria. Afr. J Agric. Res. 2011; 6:892-895.
 19. Valadabadi SA, Farahani HA. Investigation of biofertilizers influence on quantity and quality characteristics in *Nigella sativa* L. J Hort. Forestry. 2011; 3:88-92.
 20. Yimam E, Nebiyu A, Mohammed A, Getachew M. Effects of nitrogen and phosphorus fertilizers on growth, yield and yield components of black cumin (*Nigella sativa* L.) at Konta district, South West Ethiopia. J Agron. 2015; 14:112-120.
 21. Zahedifard M, Sharafzadeh S, Zolfibavariani M and Zare M. Influence of nitrogen and vermicompost on grain and oil yield of rapeseed cv. Rgs003. Bull. Env. Pharmacol. Life Sci. 2014; 3:54-57.