Research Article

Yield of Kalonji (*Nigella sativa* L.) with N-levels and foliar applications of nutrients as irrigated and un-irrigated crop

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Abstract

Yield response of *Nigella* (*Nigella sativa* L.), also known as Kalonji, was compared under the treatments N-levels (30, 60, and 90 kg ha⁻¹) and nutrients mixture “Micro Power” applications (single, double and triple) as foliar spray (FS) during vegetative growth 60, 80 and 100 days after sowing (DAS). Field experiment was conducted at Agronomy Research area, the University of Agriculture, Peshawar during winter season 2011-12 as irrigated and un-irrigated crop. Experiment was conducted in 2 x 2 factors; randomized complete block design (RCBD) and three replications each. Both experiments were initially sown on same moist soils but thereafter un-irrigated set was subjected to natural seasonal precipitation. However, the irrigated crops received two flood irrigations. Data were recorded on growth and yield during the season. ANOVA results revealed that among yield traits, grains weight decreased by 14% with increase in N-level from 30 to 60 kg ha⁻¹ but did not differ at treatments N 60 and 90 kg ha⁻¹. Grains per plant or capsule weight also fluctuated which was observed higher at N-level 90 than N-level 60 kg ha⁻¹. Likewise, FS influenced grains per plant with higher in single and double FS over the triple FS. Capsules weight per plant was approximately 10% higher in single FS and double FS which resulted higher grain and straw yield. The study suggested that low N application and limited FS is useful for the Kalonji crop. Higher N-level from 60 kg ha⁻¹ or FS more than single may not as advantageous to the crop as expected. Kalonji being famous for drought has also shown 13.5% higher grains and 5.75% straw with irrigations supplement.

Key words: Kalonji yield, irrigated vs. un-irrigated, N-levels, foliar applications of nutrients mixtures

Introduction

Kalonji (*Nigella sativa* L.) belongs to family *Ranunculaceae* originated in either Turkey or Italy. It is also known as black-seeds. Its plants are found throughout India like bushes [1] with a height of about half meter, terminating with blue flowers. Kalonji cultivation has been traced back more than 3,000 years to the kingdom of Assyrians and ancient Egyptians [2]. Seeds are triangular, black (shooneez) and possess aromatic pungent smell. The grains contain about 21% protein, 35% carbohydrates and 35-38% oil; 1.5% (volatile) and 37.5% (Non-volatile) [3, 4]. Seed is rich source of albumen, sugar, organic acids, and glucoside melanthin metarbin. Glucoside is generally toxic with high quantities or longer use. Arabs used the seed as medicine due to its natural steroids already mentioned in the ‘Quran’. No authentic record exists before Islamic era about the use of Kalonji.

Therapeutic uses of Kalonji seeds were started after advent of Islam when explained about their efficacy and potential on human health [5]. Hurairah (PBUH) narrated that the saying from the Prophet (PBUH) that black seeds have cure for every disease except death “Shooneez”. Observations of scholars on Hadith reveal that shooneez is equally effective for diseases if taken mixed in olive oil, honey or fresh. *Nigella* seeds still have a significant pharmaceutical use in present life [6]. Herbal remedies are in use by people as medicine or the treatment for diseases or the disorders. The seeds have been traditionally used in treatment of a number of ailments including kidney, respiratory, stomach health and intestinal health, hypertension, function of bladder and liver, circulatory and immune system support etc. [7-9]. Numerous traditional applications of *Nigella* seeds have reported as medicinal and pharmacological

activities [6, 10]. Kalonji has been proved to show multi-systemic beneficial actions on human health [11] including hypoglycemic [12], hypocholestermic [13] and antioxidant [14]. There are some controversy statements about the cardiovascular actions of *Nigella* but no effect has been reported on blood pressure [15, 16]. Although, it is reported that consistent uses of seeds decreased blood pressure and normalize heart rates [17, 18]. Oil from its seeds with bee wax can effectively be used for burns, skin infections, moisturizers, joint pain reliever, or an anti-wrinkle agent [10].

Nitrogen, one of the most essential elements, is highly volatile in soil. Its deficiency affects both vegetative growth and plant volume to result sufficient quantity of healthy grains in almost all crops [19, 20]. Kalonji is a most widely grown medicinal crop but its N application and other micro-nutrients as foliar application with and without irrigation are not known [22]. Limited information is available to quantify the crop response on un-irrigated vs irrigated with N-levels. Kalonji as a field crop have no proper production technology package of production. Effect of N-levels and foliar application of nutrients have improved understanding about yield of maximum crops [1]. We, therefore, intend to study effects of N-levels and foliar applications of nutrients on yield of Kalonji crop as irrigated and un-irrigated in Peshawar.

Materials and Methods

Field experiments were conducted under N-levels in combination with foliar applications of micro-nutrients mixtures with trade name “micro power” at Agronomy, Research Farm, the University of Agriculture, Peshawar, during winter 2011-12. Experiments were conducted in a randomized complete block design with three replications each. Two independent sets of the experiments were arranged in a single field; one as un-irrigated and other as irrigated with supplement of irrigation in crop early development phase. Field of the experiments was initially irrigated before sowing and planting was made with seed bed preparation by cultivator run with tractor twice. Both sets of experiments, the un-irrigated and irrigated, hereafter, referred as Expt. I and Expt. II, respectively were planted on same date and soil moisture content. Treatments detail of experiments were N-levels (30, 60, and 90 kg ha⁻¹) and foliar spray (FS) of micro-nutrients (1000 ml ha⁻¹) as single spray (60 days after sowing = DAS), double sprays (60 and 80 DAS) and triple sprays (60, 80 and 100 DAS). One control treatment in addition to N and FS was also included in each experiment (i.e. irrigated and un-irrigated). Details of nutrients in FS are shown in Table 1.

Crop was planted on October 25, 2011 on ridges using clean seeds of approved variety (NARC

Kalonji). Ridges were spaced at 55 cm. Phosphorus (P₂O₅) was applied at sowing from SSP at (P₂O₅) 60 kg ha⁻¹ broadcast. After field preparation, net size of an experimental unit was marked 3.0m x 2.2m accommodating four rows. All cultural practices during crop growth and development were uniform for both experiments. However, only two additional irrigations were applied to Expt. II. Crop was harvested on May 11, 2012. Foliar application was adjusted by calibration flow of mixtures per unit time using portable hand pump. Before application the foliar spray, pump was filled with water and sprayed on border extra crop to observe time and water consumption per spray pump covering the crop canopy. From this exercise for three times, we measured the average water consumed on crop canopy. Nutrients mixture was adjusted accordingly for a treatment and day. To record data grains yield and dry matter yield (g m⁻²) were focused on harvesting two central rows at maturity. On the day of harvesting (May 11th 2012), selected spots with almost even distribution of plants were marked in an experimental unit, harvested and yield was calculated for the area and converted to standard area. Bundles of the harvested materials were sun dried for ten days in field, weighed for total biomass and threshed manually for seed yield. Fresh and dry matters of grains and biomass were recorded. Sample of dry matter and seed was oven dried for 46 h at 70°C for yield estimation. Dry matter and grain yield was adjusted per unit area accordingly. Data regarding yield traits on a plant were separately counted on ten representative samples randomly selected from the experimental units. Capsules per plant, grains per capsule and thousand grains weight were manually counted and recorded at harvesting the crop in lab. All data was first computed for a standard unit based on the field observations and analyzed in computer software using Excel spreadsheet program as per format under completely randomized block design (CRBD) for the data sets. Combine analysis were made for both experiments as irrigated and un-irrigated. Means, where found significant, were separated using LSD tests (p<0.05).

Results

Among the irrigation factor, grain yield was significantly (p<0.05) influenced by the supplement irrigation than un-irrigated or rainfed crop with higher grains yield for the irrigated plots (Table 2). Foliar applications showed higher grains yield by double sprays and lower (p<0.05) with rest of the single and triple sprays. N-levels also showed a significant effect on grain yield with maximum for N 30 kg ha⁻¹ and minimum for N 90 kg ha⁻¹. Planned mean comparisons did not differ from each other (p<0.05) for grains yield data. Among the treatments combinations, interaction (FS x N-levels), Irrigation regimes x N-levels) and

(I x FS x N-levels) were all found significant ($p < 0.05$). For Interaction (N x FS), the grains yield markedly declined for N 30 to 60 kg ha⁻¹ but remain static thereafter for N-level 60 to 90 kg ha⁻¹ under single foliar spray (Fig. 1). A similar first decreasing and then a mild increasing trend were observed for grain yield data when N enhanced from 30 to 60 and from 60 to 90 kg ha⁻¹ for double foliar spray treatment. Contrary to that, grain yield showed a slight increase with a marked reduction when N enhanced from 30 to 60 and from 60 to 90 kg ha⁻¹ with triple foliar applications to the crops. The (Irrigation x N) interaction for grain yield is shown in Fig. 2. Grain yield linearly declined with an increase in N from 30 to 90 kg ha⁻¹ in the un-irrigated crop while a mild reduction observed in irrigated crop with increased N from 30 to 60 kg ha⁻¹ with no changes between N 60-90 kg ha⁻¹. The interaction (I x N x FS) was also found significant for grains yield with differences for the treatments in irrigated and un-irrigated crops (Fig. 3). The irrigated crop over the un-irrigated showed high grains yield. At single FS, there was almost a linear increase in grains yield with increase N from 30 to 60 kg ha⁻¹ and a marked decrease thereafter from N-level 60 to 90 kg ha⁻¹. Under the double FS, there was an obvious decrease in yield at N-level 30 to 60 kg ha⁻¹ with a slight increase by further increase in N-level from 60 to 90 kg ha⁻¹ as un-irrigated crop. The triple FS showed a slight reduction in grains yield between N-level 30 to 60 kg ha⁻¹ and a negligible increase thereafter between N-level 60 to 90 kg ha⁻¹. In irrigated crop, a stable decrease observed from N 30 to 90 kg ha⁻¹ if treated by single FS but double and triple FS showed a marked reduction in grains yield when N enhanced from 30 to 60 kg ha⁻¹ with mild increments for N-level 60 to 90 kg ha⁻¹ for irrigated crop. Straw yield was also significantly ($p < 0.05$) affected between irrigated and un-irrigated crops with higher for the irrigated. Foliar spray showed higher straw yield in kg ha⁻¹ with single and double applications and lower with triple applications. The N-levels also significantly affected the straw yield with higher at N-level 30 kg ha⁻¹, followed by N-level 60 and 90 kg ha⁻¹. The planned mean comparison did not differ ($p < 0.05$) for straw yield. The un-irrigated crop showed a noticeable increase in straw yield with single and double foliar spray with a reduction for double to triple FS. Contrary to this Kalonji crop showed a slight decrease by single, double and triple FS as irrigated crop. Interactive effects of treatments (I x control vs. rest) showed a regular decrease in straw yield from control to rest with different trends for control and fertilized plots (data not shown). Harvest index (%) was significantly ($p < 0.05$) different between irrigated and un-irrigated crops with higher for the irrigated. The FS showed higher harvest index with double applications and lower with single. The N-

levels showed a significant effect on harvest index with high at N-level 30 kg ha⁻¹ and low at N-level 90 kg ha⁻¹. The planned mean comparison did not differ ($p < 0.05$) from each other for harvest index. Interactive effect of (N x FS) showed a markedly decrease at single and double FS with an increase of N-level from 30 to 60 kg ha⁻¹ and a slightly increased with further enhancement of N-level from 60 to 90 kg ha⁻¹. The triple FS showed a slight increase and a decrease when N-level was enhanced from 30 to 60 kg ha⁻¹ and 60 to 90 kg ha⁻¹ (Fig. 1). Interactive effects (I x N) for harvest index revealed that harvest index (%) of un-irrigated crop remained stable to decrease by increasing N-level from 30 to 60 and 60 to 90 kg ha⁻¹ (Fig. 2) while in the irrigated crop a marked reduction observed with increase N-level from 30 to 60 and from 60 to 90 kg ha⁻¹.

Data regarding 1000 grains weight (g), capsules plant⁻¹, grains plant⁻¹ and capsules weight plant⁻¹ are shown in Table 2. A non-significant ($p < 0.05$) difference was seen between un-irrigated and irrigated crops for 1000 grains weight. Foliar spray did not show any significant ($p < 0.05$) responses on grains weight. However, different N-level showed significant ($p < 0.05$) effects on grains weight (g) with highest grains weight for N-level 30 kg ha⁻¹, followed by a significant ($p < 0.05$) decrease at N-level 60 kg ha⁻¹ and N 90 kg ha⁻¹. Treatments N-level 60 and 90 kg ha⁻¹ did not differ ($p < 0.05$) from each other in 1000 grains weight data. Planned mean comparison (C vs. R) did not differ in grains weight data (data not shown). The interaction (N x FS) was significant for 1000 grains weight (Fig. 1). The grains weight markedly increase for N-level 30 to 60 kg ha⁻¹ and thereafter markedly decrease with further increases in N-level to 90 kg ha⁻¹ with a single FS. By double FS the 1000 grains weight was obviously decreased in N-level 30 to 60 and then relatively more or less stable for N-level 60 and 90 kg ha⁻¹. The 1000 grains weight for triple FS was markedly decreased in N-level 30 to 60 kg ha⁻¹ and then slightly increased at N-level 90 kg ha⁻¹. Capsule plant⁻¹ were also significantly ($p < 0.05$) affected between un-irrigated and irrigated crops with higher in the irrigated crop. Foliar spray of nutrients on different dates showed a non-significant ($p < 0.05$) response on capsule per plant. The N-levels significantly ($p < 0.05$) influenced capsule per plant with higher at N-level 30 kg ha⁻¹, followed by significantly lower at N-level 90 kg ha⁻¹. The planned mean comparison did not differ from each other ($p < 0.05$) for the capsule plant⁻¹. The interaction (I x N) was significant for capsule plant⁻¹ data (Fig. 2). Capsule per plant decreased linearly in un-irrigated crop by increases N-level from 30 kg ha⁻¹ to N-level 90 kg ha⁻¹. Data regarding grains per plant were non-significantly ($p < 0.05$) different between un-irrigated and irrigated crops. Foliar spray on different dates

showed higher grains plant⁻¹ with double applications, followed by single and lowest by triple applications. The N-levels also significantly influenced grains per plant with higher for N-level 30 kg ha⁻¹ and 90 kg ha⁻¹ and significantly lower for N 60 kg ha⁻¹. The planned mean comparison i.e. control versus vs. rest (fertilized) differ statistically ($P < 0.05$) for grains per plant with higher in rest of the treatments. Grains per plant remain almost static and then decreased with increasing N-levels from 30 to 60 and 60 to 90 kg ha⁻¹ but with a higher rates in irrigated than un-irrigated crops (Fig. 4). The grains per plant decreased with different fashions for the three FS with increasing N-level from 30 to 90 kg ha⁻¹ with almost similar fashions for FS single and double but far lower with triple applications. The trends showed that grains number decreased linearly with an increase in N from N 30 to N 90 kg ha⁻¹. Data regarding capsule weight per plant (g) were found non-significant ($p < 0.05$) between irrigated and un-irrigated crops (Table 2). The FS showed significant ($p < 0.05$) effect on capsule weight plant⁻¹ with higher for single foliar followed by double applications and lowest for triple foliar applications. The N-levels also significantly affected capsule weight plant⁻¹ with higher capsule weight per plant in N 90 kg ha⁻¹, followed by N-level 30 kg ha⁻¹ and lower in the N 60 kg ha⁻¹. The planned mean comparison (i.e. the control vs. rest) statistically differ ($p < 0.05$) from each other, with higher in the control.

Discussion

Grain yield was favorably affected between irrigated and un-irrigated crops with higher yield in the irrigated crops. This shows that water is the most critical factor of production and if limited might affect growth as well as yield and yield traits of the plant. In literatures, it is reported higher grains yield be observed for the relatively drought resistant crop with water availability [22]. Foliar applications of nutrients on different date showed a significant effect on the grains yield. This showed that nutrient's with water has shown better response on crop growth though the crop is very famous as rainfed crop and most of vegetative traits did not show any significant changes but with the increases and decreases of N-levels and FS, this crop showed a favorable response on the total grains production [23, 24]. Data regarding biomass was significantly ($p < 0.05$) affected between irrigated and un-irrigated experiments with higher yield in the irrigated and lower in un-irrigated in terms of total biomass and/or straw yield which is a good sign. Foliar applications of nutrients on different dates significantly ($p < 0.05$) influenced the biomass and straw yield. According to results of other crops, both FA and N have improved some of the yield traits e.g. plant height, density, and leaf number and area that has in general increased the yield and biomass [4]. The N applications also have

significantly ($p < 0.05$) affected the biomass production, which was quite natural hat N increased plant vegetative growth as well as health [7]. Data regarding straw yield were significantly ($p < 0.05$) different between irrigated and un-irrigated crops with higher yield in irrigated and lower in un-irrigated crops. Foliar applications and N significantly affected ($p < 0.05$) straw yield. Data regarding harvest index (%) were significantly ($p < 0.05$) different between the irrigated and the un-irrigated experiments with higher for the irrigated and lower for un-irrigated crop. FA on different dates and N rates showed a significant effect on harvest index.

A non-significant ($p < 0.05$) difference was observed between the un-irrigated and irrigated crops for 1000 grains weight. This showed that N-level is not operative for the crop vegetative characters development [24]. Foliar spray (FS) applications with intervals did not show any significant effect on unit grains weight. However, different N-levels showed a significant ($p < 0.05$) response on 1000 grains weight (g). Capsule plant⁻¹ were significantly ($p < 0.05$) affected between un-irrigated and irrigated crops with higher in irrigated and lower in un-irrigated. Treatment FS showed a non-significant ($p < 0.05$) response on capsule plant⁻¹. The N-levels have significantly influenced capsule per plant Data regarding grains per plant were non-significantly ($p < 0.05$) different between the un-irrigated and the irrigated crops. Foliar applications and N-levels significantly influenced grains per plant. Data regarding capsule weight per plant(g) were non-significant ($p < 0.05$) between irrigated and un-irrigated treatments [21]. The FS of nutrients on Kalonji crop showed significant ($p < 0.05$) effects on capsule weight per plant which might has affected grains yield. N-levels significantly affected capsule weight per plant and hence in turned better grain yield [19]. The data of yield traits revealed that grains index and grains number were the most susceptible traits to applied N-levels. However, the grains per plant and grains weight were sensitive to applied N-levels that affected the grains yield of the crop with increase of its rates from low to high.

Conclusion

It can be concluded that Kalonji crop is not N-sensitive for grain yield and biomass. It cannot be incorrect to say that medium fertility soils might response better yield of Kolonji and the application **Table-1** Ingredients of nutrients mixture "micro power" applied as foliar spray during the crop vegetative growth.

Element	Quantity l ⁻¹	Quantity l ⁻¹	Element	Quantity l ⁻¹	Quantity l ⁻¹
	(w/v)			(w/v)	
Zn	2.5%	25 g	N	1.0%	10 g
Fe	1.0%	10 g	K	2.0%	20 g
B	1.0%	10 g	S	2.0%	20 g
Mn	1.0%	10 g	-	-	-

Table-2 Grain yield, straw yield, harvest indices, capsule number, grain number, grains weight and capsule weight of Kalonji supplied with N-levels and foliar sprays of nutrients 'Micro Power' for yield and yield traits as irrigated and un-irrigated crop in Peshawar.

Details	Grains yield (kg ha ⁻¹)	Straw yield	Harvest Indices (%)	Capsules (plant ⁻¹)	Grains	Seed weight (g/1000)	Capsule weight (plant ⁻¹)
Unirrigated	617 b	2743 b	18.30 b	12 b	880.8	3.20	3.60
Irrigated	700 a	2902 a	19.30 a	13 a	926.8	3.24	3.70
(P<0.05)	0.000	0.031	0.039	0.03	0.453	0.70	0.925
Foliar spray (DAS)							
Single (60)	635 b	2877 a	17.90 b	13	920.20 a	3.22	3.80 a
Double (60+80)	708 a	2854 a	19.80 a	13	926.00 a	3.24	3.70 ab
Triple (60+80+100)	632 b	2737 b	18.80 ab	12	865.20 b	3.20	3.50 b
LSD	37.30	93.2	1.20	NS	32.50	NS	0.276
N-levels (kg ha⁻¹)							
N-30	747 a	2921 a	20.30 a	14 a	900.10 a	3.50 a	3.50 b
N-60	625 b	2791 b	18.40 b	13 b	788.70 b	3.07 b	3.30 b
N-90	603 b	2755 b	17.80 b	11 c	903.80 a	3.09 b	3.70 a
LSD	37.30	93.20	1.2	0.714	32.478	0.30	0.276
Planned mean comparison							
Control (C)	630.6	2801	18.40	11.9	788.00 b	2.90	4.080 a
Rest (R)	658.4	2822	18.80	12.75	903.80 a	3.20	3.70 b
(p< 0.05)	0.30	0.70	0.60	0.082	0.00	0.061	0.00
Interactions							
				(probability)			
N x FS	0.001	0.171	0.001	0.169	0.039	0.009	0.518
I x T	0.001	0.152	0.060	0.136	0.001	0.618	0.025
Ix N	0.002	0.105	0.044	0.007	0.003	0.524	0.980
Ix FS	0.085	0.019	0.547	0.213	0.004	0.167	0.850
I x N x FS	0.015	0.990	0.121	0.995	0.190	0.805	0.521
I x (C vs. R)	0.909	0.039	0.352	0.225	0.018	0.563	0.957

Means followed by same letter within a category in columns are non-significant (p<0.05) using LSD test

of N-fertilize could adversely affect both the biomass and rain yield. Nutrients application of foliar spray showed a relatively better response on yield and yield traits. Being a drought resistant crop, irrigation supplement in early vegetative growth showed favorable response on biomass and grains yield.

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References

- Ananda N & Patil BN (2005). Effect of micronutrients (Zn and Fe) and time of nitrogen application on growth and yield of Durum Wheat. *Karnataka J. Agric. Sci.* 18 (3): 604-608.
- Khan MLA (2009). Kalonji (*Nigella sativa*). *Islamic Voice*. 13-08 (152), 1-2. <http://www.islamicvoice.com/august.99/tibb.htm#KAL>
- Anonymous. (2006). *Nigella sativa* (Black seed). www.imanproducts.com/
- Ahmad Z & Ghafoor A (2007). *Nigella sativa* – A potential commodity in crop diversification traditionally used in health care. In: Breeding of Neglected and under-utilized crops, spices and herbs. S. Ochatt and S. Mohan Jain. (Eds.): Science Publishers. 215-230.
- Al-Elyani RAA (2008). Protective effect of honey with *Nigella sativa* mixture, and the ginger on the enoxaparin sodium (anticoagulant drug) hepatotoxicity of albino rats. *Umm Al-Qura University J. Sci. Med. Eng.* 20: 39–48.
- Gilani AH, Jabeen Q and Khan MAU (2004). A review of medicinal uses and pharmacological activities of *Nigella sativa*. *Pak. J. Bio. Sci.* 7: 441–451.
- Handa SS (1998). The integration of food and medicine in India, H.D.V. Prendergast, N.L. Etkin, D.R. Harris, P.J. Houghton, Editors, *Plants for Food and Medicine*, Royal Botanic Gardens, Kew. Pp. 57–68.
- Deliorman D, Calis T, Ergun F, Dogan BS, Buharalioghu CK. & Kanzik K (2002). Studies on the vascular effects of the fractions and phenolic compound isolated from *Viscum album*. *J. Ethnopharmacol.* 72: 323-339.
- Malhotra S, Nigella K. & Peter KV (2006). Editor, *Handbook of Herbs and Spices*, Woodhead Publishing Ltd., Cambridge. 2: 206–214.
- Ramadan MF (2007). Nutritional value, functional properties and nutraceutical applications of black cumin (*Nigella sativa*): An overview. *Int. J. food Sci. Tech.*, 42: 1208-1218.
- Ali BH & Blunden G (2003). Pharmacological and toxicological properties of *Nigella sativa*: a review. *Phytotherapy Res.* 17: 299–305.
- Bamosa AO, Ali BA & Sowayan SA (1997). Effect of oral ingestion of *Nigella sativa* seed on some blood parameters. *Saudi Pharm. J.* 5: 126-129.
- Bamosa AO, Basil AA & Zubaida AA (2002). The effect of thymoquinone on blood lipids in rats. *Int. J. Pharmacol.* 46: 195-201.
- Kanter M, Meral I & Dede D (2003). Effect of *Nigella sativa* L. and *Urtica dioica* L. on lipid peroxidation, antioxidant enzyme systems and some liver enzymes in CCl₄ – treated rats. *J. Vet. Med.* 50: 264-268.
- Mahfuz M & El-Dakhakhny M (1960). Some chemical and pharmacological properties of the new anti-asthmatic drugs, Nigellone. *Egypt Pharm. Bull.*, 42: 411-424.
- Toppozadda HH, Mazloun HA & El Dakhakhny M (1965). The antibacterial properties of the *Nigella sativa* L. seeds. Active principle with some clinical applications. *J. Egypt. Med. Assoc.*, 48 (Suppl-202).
- Tahir KE, Ashour MM & AlHarbi MM (1993). The cardiovascular actions of the volatile oil of the black seed (*Nigella sativa*) in rats: Elucidation of the mechanism of action. *Gen. Pharmacol.* 24: 1123-1131.
- Zaoui A, Cherrah Y, Lacaille MA, Dubois A, Settaf H, Amarouch, & Hassar M (2000). Diuretic and hypertensive effects of *Nigella sativa* in the spontaneously hypertensive rat. *Therapie*, 55: 379-382.
- Liang Z, Bronson KF, Throp KR, Mon J, Badrudin M & Wang G (2014). Cultivar and N fertilizer rate affected yield and N use efficiency in irrigated durum wheat. *Crop Sci.* 54: 1175-1185.
- Achakzai AKK & Bangulzai MI (2006). Effect of various levels of nitrogen fertilizer on the yield and yield attributes of pea (*Pisum sativum* L.) cultivars. *Pak. J. Bot.*, 38(2): 331-340.
- Ashraf M, Ali Q & Iqbal Z (2006). Effect of nitrogen application rate on the content and composition of oil, essential oil and minerals in black cumin (*Nigella sativa* L.) seeds. *J. Sci. Food Agric.*, 86: 871–876.
- Pandey RK, Maranvilleand JW & Admou A (2000). Deficit irrigation and nitrogen effects on maize in a Sahelian environment: I. Grain yield and yield components. <http://www.sciencedirect.com/science/article/pii/S0378377400000731>.
- Khan MLA (1999). Tibbe e Nabvi (Prophet's Medicine), 13-08, No152.
- Sadeghi S, Rahnavard S & Ashrafi ZY (2009). Study importance of sowing date and plant density affect on black cumin yield. *Bot. Res. Intl.*, 2 (2): 94-98.